

Anonymous (U.S.F.S. Northern Region)

1959

PROCEEDINGS OF
NATIONAL BLISTER RUST CONTROL MEETING
SPOKANE, WASHINGTON
APRIL 20-22, 1959

In attendance - BRC Meeting - Spokane
April 20, 1959

Merle G. Lloyd	Inland Empire Res. Gen.	Spokane, Wn.
G. M. DeJarnette	R-1 T.M. R.O.	Missoula, Mont.
Harold E. Anderson	R-1 Kaniksu N.F.	Sandpoint, Ida.
E. H. Juntunen	R-1 S&PF R.O.	Missoula, Mont.
Roy Blomstrom	R-5 T.M. R.O.	San Francisco, Cal.
John F. Breakey	R-1 D&I BRC	Spokane, Wn.
Frank J. Kapil	R-1 Kootenai N.F.	Libby, Mont.
Harry J. Faulkner	R-1 Coeur d'Alene N.F.	Coeur d'Alene, Ida.
John C. Gynn	R-1 S&PF R.O.	Missoula, Mont.
T. W. Childs	PNW	Portland, Ore.
L. H. Moore	R-9 S&PF R.O.	Milwaukee, Wis.
S. D. Adams	R-9 S&PF R.O.	Milwaukee, Wis.
Henry J. Viche	R-1 S&PF R.O.	Missoula, Mont.
Quentin W. "Cap" Larson	R-1 Kaniksu N. F.	Sandpoint, Ida.
R. Z. Callahan	Inland Empire Res. Gen.	Spokane, Wn.
Elmer R. Roth	R-8 S&PF R.O.	Atlanta, Ga.
Charles A. Wellner	INT	Ogden, Utah
Thomas S. Buchanan	Forest Disease Research	Washington, D.C.
Glenn R. Allison	R-7 S&PF R.O.	Upper Darby, Pa.
James W. Kimmey	INT	Ogden, Utah
Robert V. Bega	PSW (CAL)	Berkeley, Cal.
Henry N. Putnam	R-9 S&PF R.O.	Milwaukee, Wis.
Marvin C. Riley	R-1 Clearwater N.F.	Orofino, Ida.
Clarence R. Quick	PSW (CAL)	Berkeley, Cal.
R. T. Bingham	N.Ida. Forest Genetics, Ctr.	Moscow, Ida.
Clyde J. Miller	R-1 St. Joe N.F.	St. Maries, Ida.
Virgil D. Moss	R-1 D&I BRC	Spokane, Wn.
Tom Harris	R-5 T.M. R.O.	San Francisco, Cal.
Lyle N. Anderson	R-6 Rogue River, N.F.	Medford, Ore.
Benton Howard	R-6 T.M. R.O.	Portland, Ore.
John R. George	R-7 BRC	Harrisburg, Va.
H. J. Hartman	R-1 S&PF R.O.	Missoula, Mont.
Charles Rindt	R-6 T.M. R.O.	Portland, Ore.
W. V. Benedict	W.O. Div. F.P.C.	Washington, D. C.
W. S. Swingler	W.O. S&PF	Washington, D. C.
C. P. Wessela	W.O. Div. F.P.C.	Washington, D. C.

April 20, 1959 - Chairman C. P. Wessela
Recorders - George, Anderson, Adams

Chairman C. P. Wessela called the meeting to order at 9:00 A.M. He introduced W. S. Swingler, Assistant Chief Forester, State and Private Forestry.

1. Opening Remarks by W. S. Swingler

Mr. Swingler reviewed his early contacts with the blister rust control program in Pennsylvania. He congratulated the organization for its perseverance through the years and lauded Sam Detwiler's early efforts in starting the control program. He expressed the feeling that the battle of white pine management was being won by the advances being made through ribes eradication, use of Acti-dione, breeding rust resistant pine and weevil control. He described blister rust control as the greatest holding job in the history of disease control.

Opening Remarks by W. V. Benedict

Mr. Benedict commented on the constant struggle to keep from losing BRC funds to other projects. He mentioned that the program was fortunate to have Mr. Swingler defending it and that as a result of that defense, BRC had fared well when compared with other appropriations.

Mr. Benedict gave a short history of the BRC program. He mentioned:

- a. Early scouting in the west for Blister Rust.
- b. The establishment of rust study plots in the Inland Empire.
- c. The early woods camps.
- d. The "Barrier" policy to keep rust out of Western U. S.
- e. The Administration of the BR Program by:
 1. Bureau of Plant Industry
 2. Bureau of Entomology & Plant Quarantine
 3. Forest Service

Since transfer to the Forest Service there has been marked strides in development of fungicides, rust resistant strains of white pine and studies of micro-climate. All are offering certain contributions to the overall program.

He described briefly the general change in the BR organization from a small, closely knit, highly centralized group to a decentralized, diversified organization with much broader responsibilities.

He stated that Spokane was chosen as the place for this meeting because much of the meeting was being devoted to some of the new developments originating in R-1.

2. Fungicide Use in Blister Rust Control

- (a) Results obtained to date; potentials indicated by these results; tests and experiments planned to develop full potentials - Virgil Moss, Discussion Leader.

Mr. Moss gave a report on the work that has been done in investigating anti-fungal anti-biotics for control of blister rust on infected western white pine. He reviewed the history of the investigations and described the methods of application -- excise, slit and basal stem. All have been effective but the basal stem method can be done at the lowest cost because it eliminates the time required to search for cankers.

Details of Acti-dione methods of treating trunk cankers were given as follows:

1. Basal Stem Method - Trees are not examined for infection and trunk cankers are not individually treated. All crop trees are treated. Each crop tree is treated as follows:
Acti-dione stove oil solution is simultaneously applied to the basal portion of trunk and lower branches from opposite sides of intact tree. Branches are wet 18 inches from axils in this operation. Trees less than 12 feet tall are sprayed to a height of one-third the crown lengths. Trees over 12 feet tall are sprayed to a height of 5 feet or eye level. Spray is applied down the bole while holding the nozzle about 12 inches from the trunk. Bark is wet to the runoff point.
2. Excise & Slit Methods. Trees are examined for infection and trunk cankers are individually treated.
General instructions: Limbs from the lower third of crown lengths usually are first pruned to remove branch infections and provide a measure of safety and convenience in working close to the trunk in canker treatment. Then a light film of Acti-dione-stove oil solution is applied to the diseased bark portion of trunks to distinctly outline the canker margin of surface discoloration.
 - (1) Excise Method--Dead and dying bark is removed by starting 1 to 2 inches above the distal margin of surface discoloration. Cutting is extended downward along the lateral margins to the proximal limit of canker discoloration. Then exposed tissue and bark bordering a wound is sprayed to the runoff point with Acti-dione-stove oil solution.
 - (2) Slit Method--Bark is slit at the four angular summits of surface discoloration. Two of the four slits are centered on the lateral summits and two are placed 1 to 2 inches above the distal and the proximal limits of canker discoloration. When slits fall more

than 4 inches apart, the canker margin is cut between the angular summits of surface discoloration. Bark is cut 2 to 3 inches in length to form a horizontal trough or catch-basin. These are filled with liquid in generously spraying the diseased portion of trunks with Acti-dione-stove oil solution.

Table 1.--Average percent kill and actual field costs of Acti-dione methods in the treatment of trunk cankers on sapling and pole-size trees.

Method	Acti-dione <u>1/</u> PPM	Trunk cankers treated and killed		Average costs <u>3/</u> per tree
		Treated <u>2/</u> Number	Killed Percent	
Excise	50	51	69	27.5 cents
	100	54	94	
	150	49	100	
	200	46	100	
Slit	50	48	73	19.8 cents
	100	53	96	
	150	47	100	
	200	49	100	
Basal stem	50	49	67	4.5 cents
	100	54	98	
	150	59	100	
	200	53	100	

1/ Acti-dione BR "concentrate" diluted in No. 1 fuel (stove) oil.

2/ Concentration tests based on 40 trees; 20 sapling and 20 pole with each equally divided for June and August treatments.

3/ Actual costs reported by Kaniksu National Forest in 1957 and 1958, "Progress reports on the treatment of blister rust trunk cankers on western white pine with Acti-dione on a project basis".

Foliar Application Studies

A. Status of tests through 1958

Several antibiotics in oil emulsion and aqueous solutions were applied by compression mist sprayer to foliage of 15-year-old western white pine. List includes cycloheximide semicarbazone, oxime, and acetate derivatives, Acti-dione, Phytoactin, and

Phytostreptin. Hyonic PE 30 and Triton X-155 surfactants, 0.1 to 0.2 percent were incorporated in both oil emulsion and aqueous spray solutions. Positive results in killing trunk and branch infections by foliar application were obtained with cycloheximide semicarbazone and oxime derivatives, Acti-dione and Phytoactin antibiotics. No host injury resulted from Phytoactin.

B. Aerial and hand application tests planned for 1959.

1. Aerial Application--Phytoactin and Acti-dione are to be test applied by helicopter to young pole and mature western white pine in the St. Joe National Forest. Formulations adaptable for aerial application will be developed in cooperation with the Upjohn Company and Pabst Laboratories.
2. Hand Application--New formulations of Phytoactin and Acti-dione and several antibiotics untested as foliar spray will be applied by compression mist sprayer to western white pine.

Phytoactin and Acti-dione formulations adaptable for helicopter spraying also will be applied by power fog-sprayer to sapling and pole-sized western white pine in Idaho, and to same size classes of whitebark pine, Pinus albicaulis, and limber pine, P. flexilis, in Glacier National Park.

Immunization Studies

A. Seedlings

Objective: To establish pre-infection resistance in nursery-grown seedlings by applying antibiotics to the soil for root absorption and translocation to aerial parts of plants.

Acti-dione and cycloheximide derivatives were applied as an aqueous soil drench to 1-year-old and 3-year-old western white pine potted in 1-gallon-size metal containers. Seedlings were artificially inoculated by teliospore-producing Ribes viscosissimum in a moisture-temperature control chamber, October 1958. Phytoactin and other promising antibiotics are being similarly tested. Effects of the antifungal substances on mycorrhiza are being observed in this study.

B. Established stands

Objective: To determine whether immunity is established in applying antibiotics to foliage and by trunk canker methods.

Branches on antibiotic treated trees will be artificially inoculated by the rust. A celluloid cylinder over a branch will serve as a

moisture chamber. Teliospore-producing leaves will be used for the inoculum. Until infected, branches will be re-inoculated each year to establish immunization period.

Other Antibiotics Under Investigation

Actinomycin	Duramycin	Oligomycin
Agrimycin	Endomycin	Patulin
Albemycin	Filipin	Pleocidin
Amphotericin	Fradicin	Polycycline
Anisomycin	Fungichromin	Polymixin
Bacitracin	Gramicidin	Rimocidin
<u>Candicidin*</u>	Griscofulvin	Streptomycin
Circulin	Helixin	Subtilin
Clavacin	Ilotycin	Trichothecin
Chloromycetin	Mycostatin	Tyrothricin
Chlortetracycline	Mycothricin	Viomycin
	Neomycin	

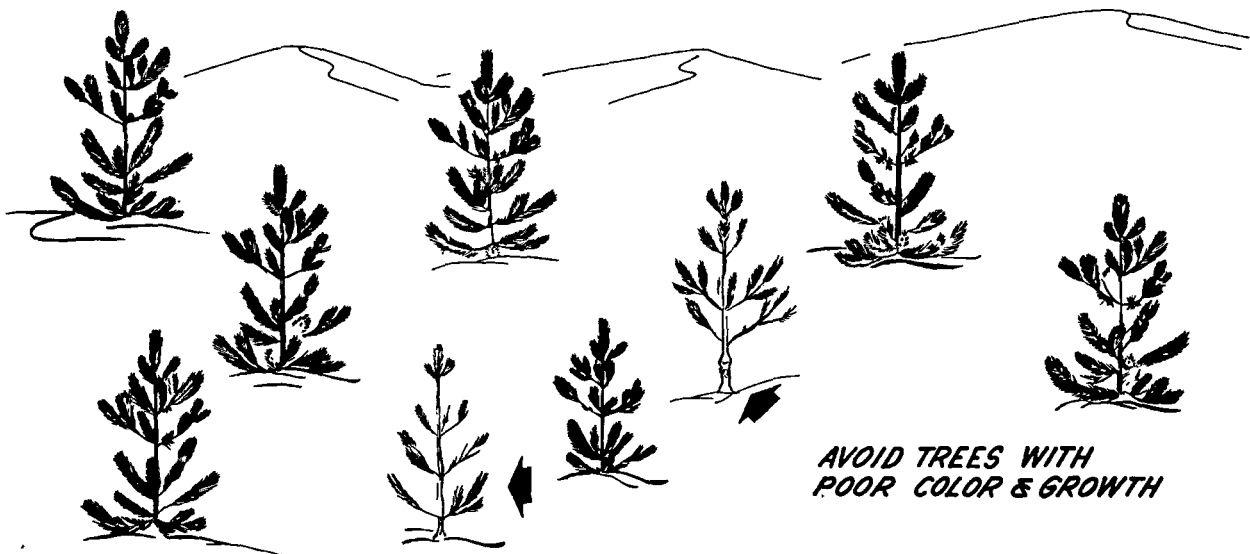
*Peter A. Ark reports "Candicidin was effective against the uredial stage of Cronartium ribicola giving 98.2 and 93.1 percent control at the rate of 1:5,000 sprayed 2 and 24 hours before inoculation, respectively". Plant Disease Reporter 40(2): 85-92, 1956.

ACTI-DIONE BASAL STEM METHOD

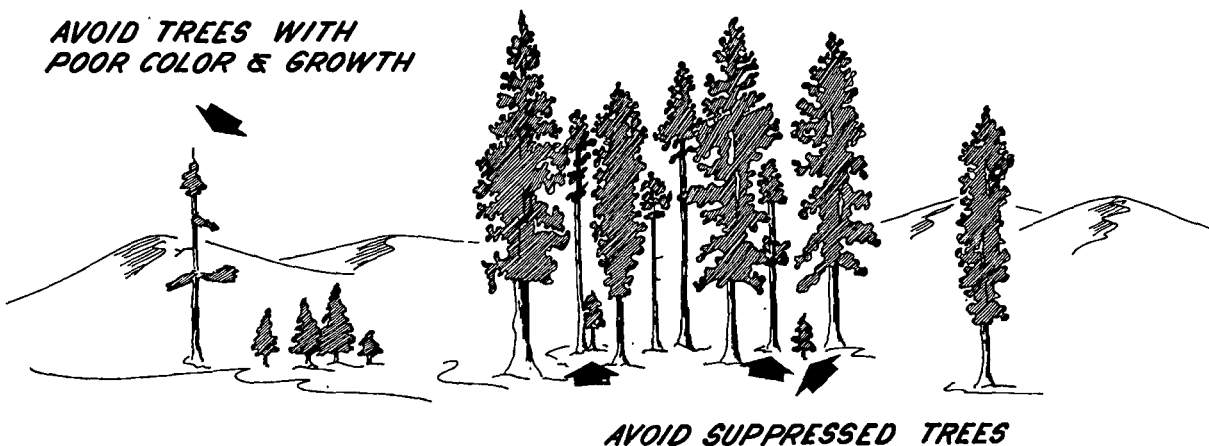
CHART NO. I

TREE SELECTION

-
- A. *PLANTATIONS LESS THAN 12 FEET TALL*
1. *ALL TREES OF GOOD COLOR AND GROWTH*



-
- B. *PLANTATIONS OVER 12 FEET TALL AND ALL
NATURAL STANDS*
1. *TREES OF GOOD COLOR AND GROWTH*
2. *OPEN GROWING TREES*
3. *CROP TREES WITHIN CLUMPS*



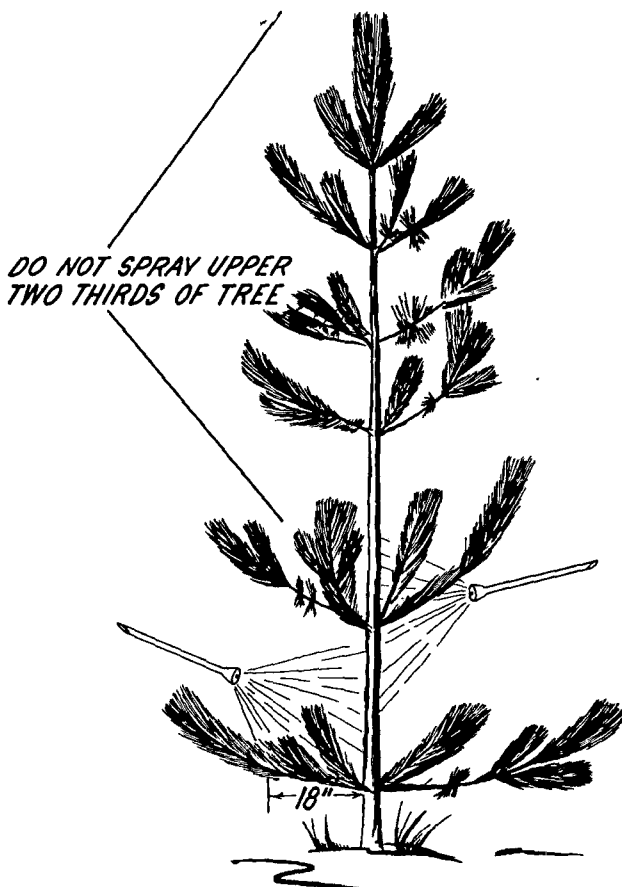
ACTI-DIONE BASAL STEM METHOD

CHART NO.2

SPRAY METHODS

1. TREES LESS THAN 12 FEET TALL SPRAY LOWER THIRD OF TRUNK
2. TREES OVER 12 FEET TALL SPRAY TO HEIGHT OF 5 FEET OR EYE LEVEL
3. APPLY SPRAY FROM OPPOSITE SIDES OF TRUNK
4. SIMULTANEOUSLY SPRAY BOTH TRUNK AND LIMBS 18 INCHES FROM AXILS
5. SPRAY FROM TOP TO BOTTOM

TREES LESS THAN 12 FEET TALL



TREES OVER 12 FEET TALL



(b) Potential Role of Systemic Fungicides in Forest Disease Control by
Dr. T. S. Buchanan

Acti-dione has been demonstrated to have great promise as an anti-fungal antibiotic against Cronartium ribicola on western white pine. The results are almost too good to be true and certainly those of us who have had a lifetime familiarity with white pine blister rust would not even have dared dream of such developments 25 years ago - or even 15 or 10 years ago. Except possibly Virg Moss!

This advance in the field of forest disease control has been so phenomenal that it is only natural to speculate on the specific future of antibiotics and the whole field of systemics in general. Pathologists have been testing for years with the hopes of discovering the ideal systemic fungicide or "chemotherapeutant" for a tree disease but without appreciable success. More effort has probably gone into experimental work with the Dutch elm disease than any other disease or host, although some of the earliest work was with chestnut blight. Little success rewarded these efforts even though the vascular elements in elm wood must compare to those in western white pine about as the Spokane River does to Paradise Creek. Then, almost out of a clear blue sky comes this amazing control of blister rust on western white pine by use of Acti-dione with undisputable evidence of at least some upward translocation or systemic action. The amazing thing here is that pine trees have not merely been protected from getting blister rust but trees already lethally infected have been cured.

To me, the point now reached with Acti-dione is not just another milestone on the path of progress. Rather it is the one isolated point of success so far encountered. We have not yet established sufficient points on a recognized curve from which we may safely extrapolate future progress and success. Nor do I think our progress will follow a progressively rising curve, in any event, but rather will be marked by a series of major "breakthroughs" punctuating intervening periods of dismal failures.

Consider all the things that have to be "just right" before we can have a systemic control for any disease on any forest tree:

1. First we have to get the effective ingredient into the translocation stream of the host tree.

Now let's stop and think a moment about the variables that might enter into consideration here:

A. How to apply the material

- i. Soil drench
- ii. Foliar spray
- iii. Stem application
- iv. Injection
- v. Seed treatment

B. When to apply the material

- i. At what chronological age of the plant; seed, seedling, sapling, pole, mature tree, etc.?
- ii. At what season of the year or perhaps even at what time of day or night is most propitious?

C. What to use as a carrier or medium

2. The active ingredient has to be fungicidal or fungistatic if we are concerned with a fungus disease or bactericidal or bacteristatic in case of a bacterial cause.
 - A. This suggests hundreds of chemicals that might qualify. Included among these now are several antibiotics and an intensive screening process involving a large number of fungi and bacteria is in progress with new antibiotics reported with regularity. The search for antibiotics is no longer confined to bacteria and fungi but has extended into other groups of living organisms, including the higher plants, protozoans, nematodes, and even spiders.
3. The active ingredient (and the carrier) must not be phytotoxic to the host tree. This may involve consideration not only of the specific formulation of the material but be dependent upon the concentrations used.

Now if we multiply all these variables together and then multiply this answer by X diseases and X species of susceptibles, we get some idea of why systemic control of forest disease is no more common than it is and why we are so fortunate even to have discovered Acti-dione as being effective against C. ribicola on western white pine.

Of course I do not wish nor intend to be pessimistic but neither would I want to be responsible for raising undue optimism on anyone's part. But we do have logical avenues, some more logical than others, of research to pursue on the basis of this one success with Acti-dione against blister rust on western white pine:

1. Try it on the same disease on other closely related susceptibles.
2. Try it on closely related diseases on closely related susceptibles.
3. Try it on different diseases on the same susceptible.
4. Try it on different diseases on closely related susceptibles.
5. Try it on different diseases on entirely different susceptibles, and finally,
6. Try different antibiotics (or systemics) against C. ribicola on western white pine.

Let's check the record and see how many of these leads have been followed -

1. Acti-dione has been or is being tried against Cronartium ribicola on Pinus strobus, P. lambertiana, P. albicaulis, and P. flexilis. Here the success has not been too consistent, phytotoxic reactions sometimes masking other effects, and excellent control on other species. In all fairness, however, it must be stated that the tests have been most sketchy compared to what has been done with P. monticola.
2. It is being tried on or trials are planned for Cronartium fusiforme, C. comandra, C. comptoniae, C. stalactiforme, C. harknessii, and C. strobilinum on their respective pine hosts. Trials too sketchy and too recent to give results.
3. It has been tried (probably only accidentally) against Armillaria mellea on Pinus monticola with some evidence of success.
4. It has been tried against dwarfmistletoes on ponderosa pine. Elytroderma needle blight on ponderosa pine, and brown spot needle disease on longleaf pine.
5. Acti-dione has been tried on Douglas-fir cone mold, leaf spot of black cherry, oak wilt, and chestnut blight.
6. Phytoactin, and phytostreptin are now being tried against C. ribicola on P. monticola.

As a matter of fact, the manufacturers have supplied experimental lots of Acti-dione to at least 70 different investigators in 7 different countries for trials against more than 35 tree diseases.

All avenues of logical follow-up are being pursued but the period of research has been too short to permit conclusions to be drawn. It does look like, with proper adjustment of formulation, concentration, timing, etc. that Acti-dione may be somewhat effective also against certain other diseases, but to no avail against still others. In any event I think it is already obvious that Acti-dione is not apt to be the penicillin of the plant world.

When we think back over that list of variables that has to be considered in testing any new systemic we cannot help but be impressed by the magnitude of the testing job that could and probably should be done. I do not think we will ever know what fungicide, be it an antibiotic, organic, or inorganic compound, will be effective against what disease organism on what host until it is tried. That has been the whole history of agricultural chemicals and even of antibiotics in the field of animal diseases. There is no formula that can be applied as new compounds are developed to forecast wherein they might be effective - it is a simple(?) matter of trial and error. I think this aspect of the problem is important because it gives us some insight into the magnitude of the job

ahead. There is room in the field for dozens, yes, even hundreds of investigators, if a thorough and complete research job is to be done.

So far I have mentioned only the desirable features and the prospects of tree disease control by means of systemic fungicides, antibiotics especially. Eventually, and the sooner the better, we have to find out whether or not an otherwise acceptable control chemical has any undesirable side effects and gather more detail on its specific behavior. We have to know these things for we already have some excellent fungicides except for the fact that they also kill the host tree.

1. Its rate of absorption by the host plant and its rate and direction of translocation.
2. Its stability - is it chemically stable or does it eventually break down and, if so, into what?
3. Its performance - how long does the material remain effective in the plant tissues?
4. Any accumulative effects - will repeated dosing tend to have any undesirable effects not apparent with single treatments? How frequently can dosages be repeated? Does the material tend to accumulate in any particular parts or tissues of the plant?
5. Its toxicity - both to the host and to other plants and to animals that might be exposed or come in contact with the material in field use.

Here again a great deal of research is called for before we know all we should of the behavior of even an apparently successful systemic, i.e., successful from the standpoint of disease control. In other words, we are continually searching for a selective chemical, one that will kill the disease organism but not harm the host tree. To know these things will surely be helpful in working out the details of successful application and might be useful in giving clues as to just exactly what are the specifications for a successful systemic. Increased research on basic normal tree physiology might also yield results helpful in the empirical screening of potential systemics. But once again I would say, let's continue to exploit Moss' success with Acti-dione to the fullest but let's not abandon all other methods of blister rust control as being outmoded and antiquated. And the same is true, only more so, for other diseases now under study. An effective systemic gives us another weapon to use in our fight against diseases. Sometimes one weapon will be more effective than another, and generally we will need to use all weapons at our disposal.

The factor of cost has yet to be fully evaluated and, in the final analysis, it is often costs and returns that determine if a disease

control program is put into effect - even though its biological soundness is unquestioned. Cost of materials and cost of application have to be known and both are dependent to some extent upon how frequently the systemic (or whatever) has to be applied. These costs, plus any detrimental side effects, have to be compared to the values saved - tangible and intangible - and to alternative methods at our disposal.

We would use an antibiotic in preference to any other chemical control agent only if:

1. It was more effective for the job at hand.
2. It was less expensive, considering both material and cost of application.
3. It has fewer harmful side effects.

As a matter of fact, these are the only reasons we would use an antibiotic instead of some stand management, silvicultural, or biological control. This is to say, antibiotics and systemics in general are just an added possible method of disease control whose relative merits have to be weighed against other alternatives.

(c) Review of fungicide tests underway in R-5, 6, 7, 8 and 9
In R-5, T. H. Harris, Discussion Leader

Fifty young infected sugar pine were treated in 1957. Results were indeterminate at time of examination in 1958, but it is apparent that Acti-dione in stove oil is not reacting the same as it does on western white pine. In the fall of 1958 another 20 infected sugar pine were treated. These will be examined in 1959. The Experiment Station feels that Acti-dione is more phytotoxic to sugar pine than to western white pine. Plans are to try other fungicides on sugar pine. Adequate testing is difficult as rust is concentrated in the northern part of the Region and there are very few plantations to work on.

In Region 6, Benton Howard, Discussion Leader

A series of field trials will be done on western white pine and sugar pine in 1959. Three forests will make tests. In each series 30 trees will be treated: 10 with juvenile, 10 with pycnial, and 10 with aelial cankers.

Western White Pine

<u>Method</u>	<u>Dosage</u>	<u>Trees</u>		<u>Forest</u>
Basal Stem	50 PPM	30 Poles	30 Repro.	Gifford Pinchot
	100 PPM	30 "	30 "	Rogue River
	150 PPM	30 "	30 "	Gifford Pinchot
	200 PPM	30 "	30 "	Rogue River
		120 "	120 "	
Slit	50 PPM	30 Poles	30 Repro.	Gifford Pinchot
	100 PPM	30 "	30 "	Rogue River
	150 PPM	30 "	30 "	Gifford Pinchot
	200 PPM	30 "	30 "	Rogue River
		120 "	120 "	

Sugar Pine

Basal Stem	50 PPM	30 Poles	30 Repro.	Umpqua
	100 PPM	30 "	30 "	Rogue River
	150 PPM	30 "	30 "	Umpqua
	200 PPM	30 "	30 "	Rogue River
		120 "	120 "	
Slit	50 PPM	30 Poles	30 Repro.	Umpqua
	100 PPM	30 "	30 "	Rogue River
	150 PPM	30 "	30 "	Umpqua
	200 PPM	30 "	30 "	Rogue River
		120 "	120 "	

Tests will follow the pattern suggested in Virgil Moss' memorandum of September 3, 1958 (P(BR) ERADICATION, Canker Removal, Acti-dione) to E. H. Juntunen.

George Harvey of the PNW is starting some tests on seedlings at the Wind River Nursery. Objectives of these tests are:

1. To see if infection can be prevented on nursery seedlings.
2. To determine optimum rate of application of Acti-dione.
3. To determine if protection will persist for two or more seasons.

The experiment is designed as follows:

1. 2-0 western white pine and 2-0 sugar pine seedlings in seed beds will be treated. Some in 1959, and some in 1960.
2. Four concentrations will be tested -- will be sprayed on seedlings.
3. Treated seedlings will be transplanted in randomized design and artificially inoculated in 1959 and 1960.
4. Seedlings will be examined for the three succeeding years following treatment.

Study should be finished in the spring of 1963.

In Regions 7 & 8, G. R. Allison, Discussion Leader

Early in October we issued instructions for testing Acti-dione on eastern white pine in Region 7. Our instructions were to test the Acti-dione using 3 different application methods and 3 different dosage strengths each on seedlings and saplings. Likewise a few uninfected small trees should be treated to test the toxicity to eastern white pine.

I do not have a full report on all plots because they were established so recently. We are not skilled in our observations and prefer to wait for rather definite indications before we try to determine the effects of Acti-dione on the canker.

From the partial reports, we probably have a thousand infected trees treated on about 60 plots in Maine, New Hampshire, Vermont, Massachusetts, New York, Virginia and West Virginia. We have asked for plots to be established in North Carolina and Tennessee.

Preliminary observations indicate:

- a. Acti-dione is not severely toxic to eastern white pine. Some branches have died that had cankers which had been treated. We do not have any case of a tree being killed.
- b. While meager, the indications are that the cankers are killed or arrested.
- c. Apparently rodents are attracted to Acti-dione treated cankers.
- d. By late summer we hope to have sufficient data to determine just how effective Acti-dione is on eastern white pine.

In Region 9, H. N. Putnam, Discussion Leader

Our interest in the use of Acti-dione was stimulated by Benedict's letter to Regions of September 9, 1958 and Moss' accompanying letter to Juntunen of September 3, 1958.

We have done experimental work along following lines:

- A. Excise trunk cankers, make vertical slits in back, apply Acti-dione 150 to 200 PPM in No. 1 stove oil.
- B. Above, using horizontal slit at top of canker.
- C. Basal spray infected trees with above, without slitting back.
- D. Basal spray on all crop trees, infected or not.

Michigan Experiment

During week of October 13, 1958 we ran an experiment on sapling white pine in Oscoda County. Four square chain contiguous areas were chosen and treated with Acti-dione 150PPM in No. 1 stove oil applied in a compressed air paint spray gun. Treatment was as follows:

- A. First Square Chain. All white pine were treated with basal spray. 86 trees treated, of which 13 had cankers.
- B. Second Square Chain. Only cankered trees treated, 7 in all, by making horizontal slit at top of canker, and spraying to dripping point. Each tree recorded separately, and all cankers above trunk canker recorded but not treated.
- C. Third Square Chain. 30 crop trees selected. Each tree pruned to 5 live top whorls. Each tree given a basal spray, tagged, recorded separately, including all cankers.
- D. Fourth Square Chain. Check plot. This experimental area will be examined this spring with much interest.

Spraying Nursery Stock

About in June, 1958, Ritter at Badoura State Nursery, Minnesota sprayed several thousand 1-0 white pine in seed beds with Acti-dione 200 PPM in water. About 6 weeks later the foliage had assumed a brownish cast, which had largely disappeared by October, and there was only slight color difference between sprayed and unsprayed. This spring Licke will plant 500 of the treated and 500 of the untreated, keeping a record of each, in an area of heavy ribes and rust. The purpose is to determine what, if any, resistance to the rust has been brought about by spraying trees with Acti-dione.

Vertical vs. Horizontal Slit Methods

In the fall of 1958 near Badoura State Nursery we treated cankered trees in a plantation, 1 row by making vertical slits, and 1 row by horizontal slits at the top of the canker. Acti-dione in No. 1 stove oil at 150 PPM was applied.

Treatment at Different Times of Year

Leaders in the field are treating cankers every month of the year. It is too soon to note results. If we have equal success in fall and winter as during the growing season, this will effectively increase the season of field activity.

Results

To the end of 1958 practically 600 infected pines had been experimentally healed with Acti-dione. While it is still too early to see conclusive results, observations on earliest treatments are encouraging.

Certain preliminary observations are made:

- A. Kerosene is a better carrier than Sovaspray.
 - B. Good success in killing branch trunk cankers in trunk.
 - C. Poor success so far in killing trunk cankers, may die later.
 - D. Treatments made in October, April and June show similar results.
 - E. Movement of chemical through bark and wood:
 1. Very little upward movement
 2. Poor side movement
 3. Good downward movement
 - F. Vertical gouges may be more effective than vertical slits.
- (d) What each Region can do to expedite fungicide testing on different species of white pine.
Virgil Moss, Discussion Leader
1. Test the phytotoxicity of oil and other possible carriers.
 2. Use different concentrations of the antibiotics.
 3. Use both the slit and basal stem method. (The excise method has no advantage over the other two.) Slit has worked 100% but basal stem may prove to be best.
 4. Test the less toxic formulations on sugar pine.
 5. Test other systemic fungicides. The Upjohn and Pabst Laboratories will have materials available for testing this spring.
 6. Observe effect of rodent and insect damage.

- (e) In view of the demonstrated effectiveness of Acti-dione and other antifungal antibiotics on infected western white pine, what modifications in control practices can and should be made in R-1?
Homer Hartman, Discussion Leader

In Region 1 - 300,000 were treated in 1958 and expect to treat a million in 1959, mostly within control area. Acti-dione treatments will also be made in high use areas and on selected pole stands now outside present control units. Three treatments in 60 years will bring stand through to 100 years. It may be possible to treat pine woodlots and increase owners investments. In time, spraying with fixed wing plane may be possible at a \$5.00 per acre cost. Helicopter will be tried this year. Use of antibiotics will extend work season. Maintenance areas may be treated with Acti-dione cheaper than the complete clean up of ribes. We must be on the lookout for side effects (good and bad) of the antibiotic. Tests should be made by artificial inoculation to determine immunization. Acti-dione should work on mixed ownership areas. Consideration should be given to using a combination of ribes eradication and Acti-dione treatment. Research is needed to determine the possibility of causing root rots, soil alteration, etc. through the use of antibiotic fungicides.

- (f) Coordination needed in fungicide use and testing.
W. V. Benedict, Discussion Leader

The encouraging leads of Region 1 should be nailed down as rapidly as possible. The use of Acti-dione will be greatest here where the problem is greatest. Some sort of clearing house for getting new developments to the other regions should be set up. Coordination of testing is needed. (No definite plan for obtaining proper coordination was agreed upon by the group.)

April 21 - Chairman, Henry Viche
Recorders - Blomstrom, Howard, Allison

1. Rust Resistant White Pine Development Program

(a) Status, outlook and plans in Region 1
R. W. Bingham, Discussion Leader

The Region now has a tree breeding orchard established at Moscow, Idaho from progeny of rust resistant crosses.

The Region has four good rust resistant transmitters which have general combining ability. Cross pollinating these trees produced progeny of which 30% are resistant when inoculated under artificial conditions. Field resistance will probably be higher. These 4 parents may be basis for breeding orchard although Bingham would like at least 30 or 40 clones since that number would provide a better seed orchard.

There will be a large scale planting of rust resistant progeny in ribes areas.

Resistance occurs in several ways in the progeny:

- (1) Needle resistance
- (2) Shed needles before infection reaches bark
- (3) Hypersensitivity
- (4) Conking out in the bark

For best results in seed orchard need about 30 clones. This will prevent selfing which reduces height growth about 20-30%.

Tests on cultivation, watering and fertilization shows promise of early flower induction.

Tests are underway to determine physiological causes of resistance.

In Region 5, C. R. Quick, Discussion Leader

- (1) General. Background of project is matter of record. Headquarters mostly at Berkeley; soon move to Placerville.
- (2) RR-SP Candidate Trees

1956, and before. DRM 10 (Scattered)
1957 Showalter 40 Klamath N.F.
1958 Showalter 30 Klamath, Shasta-Trinity, Six Rivers N.F's.

5 groups of candidates; others scattered.

Many too small to bear cones.

A few too big to climb.

25 more than 50 feet tall; 13 more than 15" DBH.

No search crew planned for 1959.

(3) Grafting: Stock.

Mostly 2-0 and 3-0 stock, Magolia State Nursery

Mostly potted in Magolia (red earth) soil

Stock 3 to 5 years old when grafted

Propose to try field grafting of lived-out stock at Placerville

May try ponderosa pine as understock

(4) Grafting: Season.

1956 (Spring) Lost all but 15 out 300; mostly lost understock.

1957 (Spring) DRM Slow continuing losses. Now 45/250.

1958 (Spring) Q,B,McG. Fair to good. Now 120/245.

1958 (Summer) Quick No good at all. Now 1/50.

1958 (November) Quick. Best; or most recent? Now 48/52.

(5) Grafting: Type. (Describe)

Bottle (veneer) grafts show high immediate "take", but slow

continuing losses, and growth confusion

Some grafts drop all buds and just sit and sit.

Very often a tendency to multiple equal terminal buds.

Tip-cleft grafts perhaps give best growth

Stump-cleft grafts good in fall only. (Table)

Variables still numerous and troublesome.

(6) Outplanting.

One outplanting site under development near Happy Camp.

(7) Vegetative Propagation.

Big attractiveness, but big problem also.

1957-58 85 cultures. Half & Half needle-bundle and stem.

2 rooted, none grew.

1958-59 240 cultures. Mostly needle-bundle tests.

Set up in series. Varying materials and concentrations

Commonly contain hormone, carbohydrate, fungicide.

Best hormone to date: Indole-butyric and

Best fungicide: Brilliant Green. Other good "fungicides":

Mangate, Propylene Glycol, Fermate, Sodium Benzoate.

Hope to bear down a little harder on this.

(8) Phenology of Candidate Trees

Description difficulties. Tree #36 Black Bear Summit, 4450.

Quick was all thru crown on 6-17-58

Many cones (both kinds) in evidence, but green.

Guessed conelets should be bagged in 3 weeks.

Showalter back on 7-7-58; pollen mostly shed; conelets thought "gone by".

Another tree on river, Sawyer's Bar, 2150; shedding pollen 6-17-58

Hope to work on this aspect, this year.

(9) Cone Aborting Beetles (Second Year Cones)

Tree #36 Black Bear, all 1958 cones all gone 6-17-58.

Tree #OT Gridley Ridge. Bagged 7 cones (4 tips) 4-29-58.

Left 8 cones (6 tips) unbagged.

On 6-19-58 all bagged cones OK; all unbagged, gone.

Bags, cones, and seeds exceedingly pitchy; but germinated.

No open-pollinated cones matured on candidates, 1958.

Like to try injection of systemic insecticides.

Bags were made of cotton feed sacks. Left on until

Nov. 1958. Seeds and cones OK.

(10) Other.

Bark-grafting experiments. Objective, implement, process, apparent success.

Limb-girdling experiments. Objective, implements, process, hope it works.

RR-SP. Problems to Solve. (We have plenty.)

Method for determining stage of phenology.

Best choice and use of fertilizers.

Degree and rapidity of clearing about candidates.

Develop chemical or other method for forcing flowering.

Methods for testing mature trees for resistance.

Methods for control of cone-aborting beetles.

Best methods for transporting scionwood.

Final use of ponderosa pine as RR-SP understock.

How obviate growth confusion after grafting.

Try to develop cuttage methods of propagation.

Rust-Resistant Sugar-Pine Candidates
Grafts of November 1958
Lath-House, Gill Tract, Berkeley

Tree Number #	Type of Graft	Under Stock	Grafts Made	Number of Grafts By Vigor Rating, April 1, 1959 ***						Total Surviving Grafts
				E	G	F	P	VP	D	
44	Tip Cleft	Magalia SP.	20	8	8	3	-	-	(1)	19
44	Stump-Cleft	" "	4	1	2	1	-	-	-	4
44	Tip-Cleft	Jeffrey Pine	1	1	-	-	-	-	-	1
44	Tip-Cleft	Jap. Black Pine	1	-	1	-	-	-	-	1
7/1	Bottle*	Magalia SP	10	-	9	1	-	-	-	10
7/1	Bottle**	" "	10	-	7	3	-	-	-	10
7/1	Stump-Cleft	" "	6	2	1	1	(1)	-	(1)	5
			52	12	28	9	(1)	Q	(2)	50

40

10

* Wrapped with red-rubber grafting branch only.

** Grafting branch plus grafting asphalt emulsion.

***Vigor rating (visual). E=Excellent, G=Good, F=Fair, P=Poor, VP=Very Poor, D=Dead.

#44 is small tree in open, High Point south of Black Bear Summit, south of Sawyer's Bar.

#7/1 is tree 1, Supan Road, NE of Montgomery Creek

Grafted Nov. 12-13, 1958.

Checked April 1, 1959.

Q. 4-2-59

In Region 6 Benton Howard, Discussion Leader

Projects underway or accomplished as of April 1, 1959:

(1) Search for resistant candidate trees:

- a. Searching has yielded to date: 145 trees (P. monticola)
35 " (P. Lambertiana)
- b. No searching is planned for 1959, as more western white pine trees have been found, than can be worked in '59 and '60. Further searching is anticipated in F.Y. 1961. Sugar pine stands will be checked in F.Y. 1960 to locate resistant trees which are of cone-bearing age.

(2) Progeny-testing:

Seedlings from open-pollinated seed from 14 resistant white pines will be progeny-tested by Experiment Station personnel in the fall of 1959. Seedlings from similar origin from 45 resistant candidates were artificially inoculated in the fall of 1958. No results are recognizable yet.

(3) Grafting:

Grafting of scions from resistant candidates on to potted stock was tried in 1957 and 1958. Only 5-10 scions from each candidate were grafted as the purpose was to preserve plasm of parent trees.

- a. Number of grafts made in 1957--about 200.
(Success not finally determined, but it is estimated that less than 20% will survive outplanting.)
- b. Grafts made in 1958--white pine - about 275; sugar pine - about 125.
(Estimated success of outplanted grafts - 30%-40%.)
- c. Future grafting will be restricted to clefts made on vigorous-growing, outplanted or natural seedlings. White and sugar pine seedlings are being planted in two areas for use as understock. (Mill Creek, Dorena).
- d. Grafts in 1959 - western white pine - 500.
 - 1) Scions from resistant trees at Bohemia will be grafted onto vigorous understock about four feet tall at Jim Creek, Prospect District, Rogue River National Forest. This will be a "breeding orchard".

- 2) Controlled pollination within the orchard will be employed to get resistant F_1 progeny for planting.

(4) Controlled pollination of resistant white pines:

- a. Spring of 1958: Number of bags placed - 97
" selved - 49
" crossed - 48
- b. Spring of 1959: Number of bags planned (WWP) - 563
" " " " (SP) - 100
(Code: NF - Trees - Bags: Umpqua - 15 - 283; Olympic - 10 - 140;
Mt. Hood - 5 - 70; Mt. Rainier - 5 - 70; (SP - Umpqua,
Rogue River, Siskiyou - 10 - 100).
(Note: Five bags on each tree to be selved. Additional bags
will be for crossing with two, possibly three test
parents in each area.
For example: Tree 1: 5 selves, 5-1x8, 5-1x13, 5-1x23.
Tree 2: 5 " , 5-2x8, 5-2x13, 5-2x23.
Tree 3: 5 " , 5-3-23 (no more conelets).

(5) Cone induction methods:

- a. Commercial fertilizers such as 16-20-0 and 10-10-10 have been applied at 5-20 pounds per tree. No indication of either cone induction or damage to the resistant trees has been observed. A more controlled program is planned in 1959, particularly with regard to sugar pine.
- b. Applications within a 10-foot cleared radius of 20-10-10 fertilizer at a rate of 10 pounds per tree has been recommended. Some control trees on the Rogue have been suggested for 15 and 20-pound applications. Pruning lower branches, watering and partial girdling of control (non-resistant) trees is planned also.

- (6) Two seed orchards designed to permit controlled breeding are being initiated: One at Jim Creek on the Rogue, and one at Dorena. A third area at Mill Creek may develop to this status in the future. When flowers are produced on the grafts, controlled pollination will be employed.

(7) Training:

Field training on each project will be done by Tom Greathouse as a supplement to Forest Genetics short course.

(8) Hybrid:

If Himalayan pine pollen (*P. Griffithii*) is available from the Placerville Institute of Forest Genetics, 100 bags will be pollinated with this. (WWP - 80, SP - 20.)

- (9) If a lack of cone flowers makes it necessary, some bags may be placed on Snoqualmie resistant white pines in lieu of Olympic or Mt. Rainier trees.

(10) Mill Creek:

About 500 sugar pine seedlings and 50 potted grafts from resistant parents will be outplanted this spring. The 500 seedlings will be for future use as understocks in an archive of resistant scion material.

In Region 7 G. R. Allison, Discussion Leader

The Region has been working intermittently with Dr. Hirt in finding rust resistant candidates and with Dr. Riker in outplanting rust resistant test pines. In the outplantings nearly all of Dr. Riker's trees have shown complete resistance to the rust. Control trees have all become cankered and most of them have died. The rust resistant grafts show very poor form. They are not vigorous and many have died from causes other than blister rust.

In Region 9 H. N. Putnam, Discussion Leader

Introduction

Study initiated by Dr. Riker in 1937.
Acreage for BR Nursery south of Wisconsin Rapids leased to State by Nekoosa-Edwards Paper Company.
Sandy soil adjoining a clear flowing creek.
250 white pine from areas where rust had been present for some time selected as possibly resistant. 60 showed degrees of resistance.
Seedlings and grafts exposed naturally and artificially inoculated in replications in nursery.
Selected seedlings and grafts several years ago were planted in 8 deer exclosures in northern Wisconsin, and two in northern Minnesota.

Agencies Involved

Three agencies are working cooperatively on this project, each giving special attention to certain phases of the problem:

Lake States Forest Experiment Station
Dept. of Plant Pathology, University of Wisconsin
Quetico-Superior Wilderness Research Center, Ely, Minnesota.
Established by Hubachek, run by Cliff E. Ahlgren.

Status of Program by Agencies

Lake States Forest Experiment Station.

This work handled by Dr. Ralph Anderson in close cooperation with the other two agencies. Activities are mainly along three lines:

- (1) Maintenance of deer exclosure plots of apparently rust-resistant white pine seedlings and grafts. Some plots were established in 1948. No analysis is available. Fences have been maintained.
- (2) Pine inoculation tests. Efforts have been concentrated on constructing a large temperature and humidity control chamber, and developing clonal lines of various white pine species for studying effective methods of inoculating white pines.
- (3) Study of races of blister rust. For several years in cooperation with Dr. French of University of Minnesota, a study of races of the rust has been in progress. Evergreen ribes species, such as R. viburnifolium, show promise as differentials. In 1958 inoculated R. viburnifolium was heavily infected, while in previous years infection was negative. The reason is not known.

Dept. of Plant Pathology, University of Wisconsin.

Under Dr. A. J. Riker, Dr. Robert F. Patton conducts this project. In 1958 work continued along several lines as follows:

- (1) Artificial inoculations. These have heretofore been made on stock three years old. At least two and usually more years after inoculation were required to determine degree of resistance. In 1958 over 4500 seedlings from fall sowing were artificially inoculated the following fall when seedlings were four months old. Results will be examined from two aspects: (a) success of method in decreasing time factor, and (b) efficiency in technique in screening large populations for the few resistant individuals.

Two other inoculation series were set up at the BR Nursery:
(a) re-inoculation of grafts from trees of different ages;
(b) test of grafts from exotic species.

Results of telial suspension inoculation made in 1957 were disappointing, infection much less than by the leaf-pinning technique. Possibly the fact that spores were carried in minute water droplets excluded air and prevented germination. Further study will be made.

Infection records on trees previously inoculated including 1956 were summarized. Progenies from 26 selections involving nearly 800 trees. Infection ranged from 73% to 99%, with the average of 99% for several hundred seedlings. Much of the infection was recorded after only one year, and probably will go higher.

In summary there were 6 selections whose progeny showed a greater degree of resistance (8% to 19% disease free). These selections were Nos. 18, 30, 191, 327, 343, 355. The resistance in individual parents is not necessarily related to resistance in progeny. In progeny of self pollinations, the results were the same in most, except the above-named 6 good ones. In one of the 6 there were 39% disease free trees.

In crossing a resistant P. strobus with P. griffithii no degree of resistance appeared in progeny.

Amount of infection of grafts was much less than on seedling progenies or seedling controls. Grafting reduces chance for infection. Infection of grafts from trees 4 years old (70%) to trees 80 years old (27%).

- (2) Field Test Plots. The two field test plots after treatment with brush killers, were successfully replanted with white pine transplants for use as understocks for field grafting. Grafting made in field on well-established understocks are much more successful than those made in the nursery.

- (3) Flower Induction. Trees in bark inversion trial in 1955 were examined in 1958. No stimulation of flowering.

No pollen produced on grafts of F. 1 seedlings in four years in crowns of large flowering trees.

- (4) Rooting cuttings. 1958 a poor rooting year, 23% success in 1958 on controls, rooting 95% in 1955. Rooting percentage decreased markedly with advancing age on cuttings taken from 4 to 80-year old trees.

Quetico-Superior Wilderness Research Center.

This work handled by Clifford E. Ahlgren, in close cooperation with University of Wisconsin and Lake States Forest Experiment Station.

- (1) Interspecific grafting. In 1958, over 200 grafts were made, including P. cembra, Korean, P. peuce, and P. strobus grafted on red pine rootstalks. P. cembra grafts on young red pine rootstalks flowered more frequently than on other rootstalks;

(1) Interspecific grafting. Cont.

Korean pine grafts on P. strobus flowered more frequently than on other rootstalks.

(2) Intergeneric Grafting. In 1958 grafts of Korean, peuce and cembra were made on balsam fir rootstalks within a deer exclosure. Survival was 100% at end of first growing season.

(3) Resistance tests. In 1958 there were 1,000 additional native ribes transplanted into exclosures where white pines are being tested for resistance. Hybrid white pine seedlings obtained from Riker in 1955 are being watched for infection. Infection is becoming visible on both hybrids and control seedlings.

(4) Selection of possible resistant white pine. During 1958 a search over a wide area was begun for possible resistant white pine. Every such tree is marked as a source of scionwood.

Plans

Lake States Forest Experiment Station.

(1) Field testing for resistance. In agreement with the University of Wisconsin, and in cooperation with the F.P.C. Section of the R.O. and the National Forests two areas, both in high hazard zone, one on the Superior National Forest and one in Upper Michigan. Each area would be 1.75 acres in size, surrounded by a deer excluding fence, outside any control area, and suitable to planting white pine to be field tested for resistance. The stock to be furnished by the University of Wisconsin. The erection of the deer excluding fence is a large cost item. The estimated costs for 1 exclosure for the first year are as follows:

Building fence:

Material and equipment	690.00	
Labor, 110 hrs. @ 2.00	220.00	
Total fencing cost	<u>910.00</u>	910.00

Other Costs:

Site preparation	45.00	
Planting (white pine & ribes)	438.00	
Weeding	64.00	
Total Other Costs	<u>547.00</u>	<u>547.00</u>

Grand Total, 1st year, 1-1.75 acre exclosure 1,457.00

(2) Develop effective inoculation methods using the facilities for controlling temperature and humidity now being developed.

University of Wisconsin Plant Pathology Department.

- (1) Continue artificial inoculation of l-0 white pine to screen large populations for the few resistant trees.
- (2) Greatly intensify search for possibly resistant trees in nature through the active cooperation of the BRC field force.

Quetico-Superior Wilderness Research Center.

- (1) Continue along existing lines in grafting, cross breeding, etc.
- (2) Intensify search for naturally resistant trees.

General Outlook

The ultimate aim is to develop seed orchards producing trees resistant to the rust and of good form for planting on desirable sites without regard to ribes conditions.

Work started here 20 years ago. Superficially progress has been disappointingly slow. No seed orchards exist. However, necessary techniques in breeding, grafting, budding, rooting, inoculating, etc. have been worked out. Most of these techniques are valuable in many directions. With techniques already developed, and with accomplishments to date, progress towards production of resistant, well-formed white pine should be much faster in the future. This is a long-time project. We are trying to do in a generation or two what it takes nature thousands of years to accomplish.

A commercial supply of good, rust resistant white pine planting stock is not in the foreseeable future. When this is available in limited supply one good use for it would be to plant it along trout streams to provide shade, prevent runoff and muddy water.

In the meantime we must continue the ribes eradication program vigorously to protect the large acreage of young natural and planted white pine in the Region.

2. Micro-climate Studies

(a) Results to date and their practical application to control problems.

In Region 1 Merle G. Lloyd, Discussion Leader

Can the best areas for blister rust control in the Inland Empire be selected based on micro-climate thereon encountered?

A. Program aimed at answer to this question outlined in Project Analysis

1. Meteorological problem isolated: "how often do favorable and unfavorable weather conditions for rust occur under the variety of conditions of topography and vegetative cover encountered in the Inland Empire?"
2. Studies outlined to provide information needed.

B. We have some of the information needed to answer the questions asked.

1. Climatic requirements for the rust defined
 - a. Need for further definition
 - b. Need for verification of applicability to the Inland Empire
2. Weather data from long period weather stations is available
 - a. Can be used to determine chances of occurrence of favorable weather
 - b. Will provide information on overall climate in the Inland Empire
 - c. To be analyzed by machine methods (48 stations-22 long records)
3. We know a great deal about variation of micro-climate in mountains
 - a. Temperature
 - (1) Study of variation of maximum temperature in a small area
 - (a) Maximum temperature on 253 sites compared to main weather station of Priest River Experimental Forest
 - (b) Variation about the same as over entire Inland Empire
Variation -14F to +10F
Variation over IE from -16F Mt. Spokane to +10 Orofino

- (c) Correction factors to apply to temperatures at long period stations developed, to give temperature on any site
 - (d) Chances of occurrence of 10 days with maximum temperature 95F or higher determined for main station (Considered to be sufficient to inhibit rust).
 - (e) From knowledge of variation of temperature on sites from main station chances of inhibiting conditions for rust extended to sites
- (2) How frequently will high maximum temperature inhibit rust in IE?
- (a) In northern portion only on middle and lower south slopes
 - 4 in 10 years on warmest sites (small openings in brush on south slopes below 4000 ft. elevation)
 - 2 in 10 years in the open on south slopes below 3000 ft elevation
 - 1 in 10 years on the south and west edges of objects.
 - (b) In southern portion at most 5 out of 10 years on warmest sites
- (3) High temperatures during moist periods otherwise of sufficient duration to result in sporidial formation do not occur in the IE (Hirt observed that sporidia did not form on the east coast in some such situations)
- (4) How frequently does warm weather occur during the conditioning period required for production of fertile telia? (2 weeks of cool weather with no 3 consecutive days above 82F)
- (a) Could limit the rust during part of the season on south and west slopes particularly during the period prior to mid-September
 - (b) From mid-September until leaves drop in mid-October not a factor
- (5) In general temperature should not be a factor in limiting the rust except in the southern fringe of the type at lower elevations on south aspects. Not enough to designate areas where eradication not necessary

b. Moisture

- (1) Study of variation of humidity in a small area
 - (a) Humidity observed on 58 sites in same area temperature studied
 - (b) Humidity only reached 100% on slopes when raining (exception when high fog along slope)
 - (c) Air saturated practically every night meadows and valleys
- (2) Study of variation of dew occurrence in small area
 - (a) Dew observed on 25 sites in vicinity of PREF
 - (b) Formed only in the open on meadows or at valley bottoms
 - (c) Average duration of dew 9 hrs maximum 16 hrs
 - (d) Ideal conditions-clear night-light winds after day with rain
- (3) Variation of moisture over the IE that would influence rust
 - (a) Summer rainfall- local, erratic of short duration (1-2 hours)
 - Morning or early afternoon showers dried by evening
 - Late afternoon showers leave foliage wet until morning
 - (b) Fall and spring rainfall-widespread of greater duration
 - Duration and frequency with elevation
 - Greater on west than on east side of ridges.
 - Decrease with each ridge as progress to the east. Increase as approach ridge from the west.
 - (c) Variation in duration of wet foliage
 - Foliage dries faster at higher elevations than at low
 - Foliage dries faster as height above ground increases
 - Foliage dries faster on exposed sites
 - (d) Variation in humidity
 - Humidity only 100% on slopes during rain (except where high clouds persist such as upper west slopes)
 - Humidity 100% practically every night in low places
 - (e) Variation of dew over the Inland Empire
 - Occurs practically every night on meadow and valley bottoms
 - Extends periods of wetness caused by rain
 - In sheltered spots could account for much of rust in areas

- (f) Influence of favorable moisture conditions due to stream and along streams on low ground may be more important now in causing infection than stream type ribes. Infection from spores brought in by drainage winds into favored locality
- (g) Radiation and high fog
Frequent in the fall along rivers and lakes and on upper west slopes respectively
May extend moist periods due to rain in areas formed
- (h) Summary
Summer moist periods are localized. They are shorter on ridges than on meadows. They are shorter on south and west aspects than on north and east aspects.
Fall moist periods are shorter on middle and lower slopes - particularly on north and east slopes, of major ridges. Valley bottoms are the most moist-particularly north facing sheltered sites on the west side of major ridges. Upper west faces of ridges remain moist due to high fog.

c. Air movement in mountainous terrain

- (1) Study of air movement following a moist period in upper Kalispell Creek
 - (a) Silver iodide used as an air tracer
 - (b) Demonstrated flow to south (opposite to Prevailing wind during moist periods) was possible
- (2) Variation of air flow over the IE that would influence rust spread
 - (a) In the free atmosphere air flow is from the southwest during a rain, shifts to northwest as storm passes and backs to south as a new storm approaches.
 - (b) Winds near the ground are frequently from the northeast prior to and during periods with rain
 - (c) Effect of terrain and obstacles
Major ridges-lift and accelerate air mass-Lee eddies if speed of wind at ridge top less than 29mph-otherwise follows down slope
Isolated peaks-air flows around them-stronger on shoulders

Gaps and passes-strong winds through them
in direction of pass, regardless of upper
air flow, in direction of pressure force
Draws and trees-channel low level winds
if not at right angles
Winds increase with height above ground
Winds decreased for distance behind
obstacles such as line of trees.

(d) Local thermal winds

Up-slope and down-slope winds
Up-valley and down-valley winds
On-shore and off-shore winds
Local thermal winds are superimposed on
winds of free atmosphere
They are regular in their occurrence
Occurrence, however, may be delayed and
retarded or hastened and accelerated by
wind of the free atmosphere

(e) Favored areas for long distance spread

To east and south of large concentrations
of ribes located on peaks and ridges.
Normal drainage winds are hastened and
accelerated by the winds of the free
atmosphere and carry spores long distances
to meadows and valley bottoms where favor-
able moist conditions result in infection.
Cloudiness persisting on peaks and ridges
prolongs viability of spores.

C. Studies needed to obtain remainder of information needed to answer questions.

1. Complete analysis of data for long period weather stations
 - a. Time and cost of putting data on punched cards
 - b. Problem of substitution of elements measured for elements not measured on which information is desired
2. More information needed on air flow during moist periods
 - a. Study across major divide and in vicinity of isolated peak during rain
 - b. Study in areas where long distance spread suspected
3. Information needed on frequency and occurrence of valley and high fog
4. Information needed on weather patterns in areas showing rust variation
5. New type of instruments needed and being used for surveys
 - a. Mobile equipment for short period surveys
 - b. Need light, portable, battery operated wind direction and velocity recording equipment

Problem areas

A. Along streams and on sheltered meadows

1. Situation: Locally favorable moisture conditions at bottom of valleys along streams causing infection.
2. Areas long recognized
 - a. Stillinger in his work indicated that the influence of the favorable conditions along the stream might be more important than the influence of local stream type ribes.
 - b. Recognized in Timber Management Plan of Sandpoint Working Circle
 - c. Hartman in his damage appraisal of mature WWP pointed out that infection was greatest within 5 chains of the streams.
3. Examples: Benton Creek drainage and Hughes Meadow in the Kaniksu
4. Relief:
 - a. Harvest WWP along streams and manage to other species and for watershed management and recreation.
 - b. Eradication to natural barrier of slopes adjacent to area

B. Spread to the east from ribes concentration on top or east slope of ridge

1. Situation: Dense concentrations of ribes on ridges are sources of long distance spread and fall out to east. Spores carried by flow of air from west during moist periods and by drainage winds to east slopes
2. Examples:
 - a. Upper Hiatt Creek on the upper east slope of the Cabinet divide logged following insect damage. Spread to east over pole stand in Spar Lake area from dense stand of ribes in logged area.
 - b. Haugan lookout area on east slope of Bitterroots was source of long distance spread to the Savenac Nursery area to the east.
3. Relief
 - a. Leave cap of timber. Problem of keeping fire out if left as burn slope
 - b. Clear cut burn eradicate ridge tops and manage to other species if not possible to manage to WWP
 - c. Cost would have to be included in units protected. Value of receipts from sales on ridges would have to be balanced against cost of eradication

3. Relief (Cont.)

- d. Knock down these heavy concentrations on ridges. Complete eradication would not be necessary. Spore cloud is diluted with distance.

C. Spread to east from ribes concentrations on upper west slopes.

1. Situation: Dense concentrations of ribes on upper west slopes of ridges can be source of long distance spread to stands on east slopes. Ridge tops generally form natural boundary around working units. Westerly winds during moist periods carry spores over ridge top from upper west slopes and eddies carry the spores down into stands on east slopes.
2. Example: Bear Paw Ridge leading to Bead Lake Look Out in the Kaniksu. Spores carried from upper west slope of ridge into mature stand on the upper east slope in upper Bear Paw creek.
3. Relief:
 - a. Leave cap on timber on upper west slope of ridges as well as top and upper east slope if possible
 - b. Eradicate over the top of ridge to west and north of working units not just to the top of the natural boundary
 - c. Knock down these large concentrations of ribes.
 - d. Clear cut, burn, eradicate and manage to other species if not possible to manage for WWP

D. Spread to the south from ribes concentrations on isolated peaks

1. Situation: Dense concentration of ribes on top of isolated peaks source of spores for long distance spread to south as well as to east into favored moist sites for infection. Spores are carried by the winds from the west during moist periods and by the northerly winds following moist periods which are augmented by drainage winds. Favorable moist conditions for infection are found on the flats and valley bottoms particularly on the sheltered north sides of forests or knolls.
2. Examples:
 - a. Beals Butte and Shattuck Butte in the St. Joe NF
 - b. Huckleberry Mountain in the Kaniksu NF
3. Relief:
 - a. Leave cap of timber if possible
 - b. Eradicate or at least knock down these large concentrations
 - c. Clear cut, burn, eradicate and manage to other species if not possible to manage to WWP

E. Local intensification on upper west slopes of ridges

1. Situation: Locally favorable moisture conditions due to cloudiness persisting against upper west slopes causes local infection. Spores may also be carried from concentrations of ribes on upper west face of a ridge to the next ridge downwind to the east. Spores could also be lifted from the flats during the day by convection to cloud level where spore viability maintained and then carried along with clouds against west face of mountain. (Spores could be concentrated in valley bottoms in fogged areas and then lifted by convection in morning) Time lapse.
2. Example: Bertha Hill in Clearwater
3. Relief:
 - a. Local intensive eradication of middle and upper west slopes
 - b. Knock down heavy concentrations of spores on upper ridge tops downwind from peaks where stratus persists. Knock down heavy concentrations downwind on flats (west)

Favored areas for white pine

Valleys on east side of major ridges. In rain shadow. Far enough away from ridge top (at least 2 miles) to avoid fall out of spores from heavy concentrations which may develop in these areas.

1. Situation: Drainages on east side of major ridges in rain shadow do not get moist periods due to rain as frequently or of as long a duration as other areas. Cloudiness and accompanying moisture does not persist on these areas as long as west slopes. Downslope or chinook winds dry these areas out rapidly following rain.
2. Examples:
 - a. Grass valley to northeast of Silkirk Mountains on Kaniksu
 - b. Meadow and Spread Creeks to east of Purcell Mountains in Kootenai
3. Eradication may not be necessary on some of these areas or at least not as intensive as eradication if large concentrations of ribes kept off of ridges to west.

In Region 5 Robert Bega, Discussion Leader

In California we have changed our approach on micro-climate study in the past year from a concentration of climatic correlations during the ribes to pine spread in the fall to a complete overall study of the disease throughout

the time from aeciospore release in the spring to pine infection in the fall.

Three years of field and laboratory studies have shown us that temperature alone as it occurs in California has very little effect on the viability of teliospores.

In three years of study from August through October ribes were inoculated in the field in areas with varying degrees of infection from epidemic to slight (infection but no build-up over a number of years) At this time temperature and humidity records were continuously taken adjacent to these bushes and the resultant telia tested for viability. In no instance during these 3 years did we find any adverse temperature effect on the telia even though temperatures were high enough to inhibit their germinability as reported in Region 9. Data that was obtained in the field was reanalyzed in the laboratory and similar climatic conditions established in climate control chambers - again no adverse temperature effects were found on inoculated ribes plants in these chambers.

The next step then was to combine temperature and humidity and test these factors - we are still working on this phase - one part that has been completed however was a test to see what temperature and humidity extremes teliospores would tolerate. Results shown in a slide.

Slide #1 Field temperatures resulting in fertile telia.

Slide #2 Climate chamber chart test - 4 weeks each time - from inoculation to formation of telia - then telia tested for viability. Results - 100% viability.

Slide #3 Temperature-humidity effect - 24 hours at 40°C and 55% relative humidity did not inhibit telia viability. However 48 hours at 31°C and 80% relative humidity sterilized telia.

Because of negative results in our ribes to pine temperature tests we have combined other factors - one of which is aerobiology - studying aeciospore movement from northern epidemic areas to the central and southern Sierra Nevada.

This has been a real question as to why the rust hasn't built up in the southern areas - scouting records of the past 20 years showed that there was very little ribes infection from the Stanislaus NF south in any given year with no infection from Yosemite NF south even in our generally worst spread years such as 1944. This led to the conclusion that maybe we aren't getting aeciospores blown down into these areas - at least not at the right time for good ribes infection. So this then naturally led to the aeciospore disposal studies - here the problem really loomed up - how to trap the aeciospores - when to trap them and most important of all where to trap them. With the topography that we have in the Sierra Nevada it's pretty rough trying to determine how aeciospores are getting up out of deep canyons and into the upper air currents and then where are they being blown to.

I'm taking 4 major approaches to the problem -

1. Determining on the ground in heavily infected areas when the spores are being released and with smoke bombs and weather balloons what direction the ground currents are carrying them.
2. Then using weather bureau maps, I can tell the general wind direction of the various upper air currents.
3. Fortunately the insect people do their aerial surveying in early May so they are taking some of my spore traps with them on their flights and sampling the air at various elevations and various parts of the State for me.
4. The fourth approach is to pick out areas in the central and south Sierra that look like likely fall-out areas and place spore traps (both mechanical type and potted ribes) in these areas - at the same time taking climate data in these areas to use in laboratory infection studies. With all this data we can then start making positive forecasts about safe and high hazard areas.

History

1. 1944 scouting record - spread year - very little ribes infection on Stanislaus - none south. (Points out how useful old records now are.)
2. Old wind pattern records - more old data that is still useful.
3. Smoke drift - wildcat - to determine movement by ground currents
4. Deep canyons - Feather River drainage - heavily spotted with infection centers
5. Same - How are these spores getting up out of here?
6. Same - What direction are they going when they do get up?
7. Feather River Canyon from ground.
8. Small lateral canyon of Feather River drainage - Wildcat Creek
9. Spider meadow Yosemite N.P. - natural settling bowl - get pinyon blister rust here on ribes.
10. Smoke drift at spore trap sites - to determine last location of traps
11. Double-anchored weather balloon method of trapping - also serves to determine air movement above vegetation. Spore traps spaced along the onshore line at various elevations.
12. Same -

Early BR scouting in California turned up another identical fungus on ribes that gives scouts a lot of trouble - this is the pinyon rust - C. occidentale that looks exactly like C. ribicola on the leaves. Scouts have been fuming and cussing this fungus for years. Well I felt it might do some work for me. I'm comparing its infection requirements with those of blister rust to see if I can use it in the rust free control series - to determine what areas are potentially susceptible to infection if we ever do get the right conditions in the future. I can't bring blister rust into these areas but I can bring in pinyon rust - so you see it isn't such a bad fungus after all - preliminary tests have shown that their requirements are similar enough to use it.

Some of the more basic studies are done in the laboratory to determine some of the fine points of spore production, dispersal and infection.

Slide #1 Sporidia germinating on sugar pine needle - spores subjected to various temperature and humidity conditions, then placed on needles to see if they will germinate and infect. Also spores placed on the needles - then the needles subjected to various conditions and then see if can get infection.

Slide #2, 3, 4, 5

Germination difference of sporidia near sugar pine needles and by themselves - infection tube type of germination near needles - production of secondary sporidia otherwise.

Slide #6 & 7

Detached pine needle and twig tests.

Slide #8 - 11

Detached ribes leaves and branches tests

In Region 6 Benton Howard, Discussion Leader

Howard reported that there are no micro-climatic studies underway or planned for R-6. However, micro-climatic variations are obvious throughout the region. When the micro-climatic of an area can be evaluated ribes standards can be relaxed. Areas not now in program can be accepted.

In Region 7 G. R. Allison, Discussion Leader

The topography is rough and quite variable. The micro-climate can vary from chain to chain. Weather stations are separate and away from pine stands. We feel we would need a record of temperature range, rainfall, humidity, etc. at a great many locations to utilize micro-climate in our control work. On the other hand, we are using climatic effects in our control program.

In our annual report we have listed 6.8 million acres or nearly 40% of our control area as not requiring further work. This should be qualified however, as it indicated no further work unless conditions change. The area is taken out of our work plans but we maintain surveillance on it. Should infection become more intense we fully expect to move in and re-evaluate the problem.

Control area is placed in a no further work category based upon field observations. A large part of the 6-3/4 million acres in this category are ribes free. However, detailed field observations are the basis for those where ribes are associated with the pine.

Field observations, SE New Hampshire.

In some 20 townships on the SE New Hampshire coastal plain, white pine is predominate. With the exception of scattered R. cynosbati on the uplands, the ribes are confined to grassy swales. In these R. hirtellum grow with long spindly, whiplike form. They are difficult to eradicate - the rather brittle roots entangle with the roots of other vegetation such as alder, viburnum and swale grass. For this reason only token effort was made to protect this pine. Money available for control work was spent where it was felt more protection could be bought for the control dollar.

As a result very little control work was done. In 1950, a new District Leader took charge of this area. He is aggressive and started to make plans for protecting the area. Upon careful observation he found that the pine was not seriously infected with BR.

The observations led to studies and they confirmed the lack of serious rust infection. 200 surveys were made in a total of 18 different townships. Strips were run perpendicularly into the pine from the swales. Results:

10% of the pine in the first 100' of the swamp was infected.

6% of the pine in the second 100' was infected.

5% of the pine in the third 100' was infected.

4% of the pine in the fourth 100' was infected.

Beyond this the strip usually began to approach another swale.

In spite of exposure to 15 to 30 years infection we had a good stand of pine. Based on these studies, discussions with Research Pathologists and the State officials, we have discontinued work in the area and have taken the area out of our work plans.

In the S.E. below 3000 we find very little infection on pine. Evidently moisture conditions do not favor spread of the rust there.

In Region 9 H. N. Putnam, Discussion Leader

Micro-climate may be defined as the local climate surrounding individual trees or shrubs, as influenced by slope, exposure, position on slope, vegetative cover. Micro-climate is a manufactured word to cover the composite effect on local climate of the above factors.

A study of micro-climate as affecting the development of blister rust in Region 9 was a brain child of Dr. Riker. In 1951 Van Arsdel, then leader of blister rust control in Indiana, started work towards his Ph.D. at the University of Wisconsin on the subject of climatic factors affecting the distribution of blister rust in southern Wisconsin. He completed his thesis and received his degree in 1954.

After a stint in the Army he received an appointment in 1956 in the Lake States Forest Experiment Station, and was assigned to his present position at the University of Wisconsin to work in close cooperation with Dr. Riker. His subject has been expanded to include (1) weather conditions throughout the Lake States; (2) movement of air currents to and from swamps.

During Van Arsdel's time in the Army, Dr. John R. Parmeter, Jr. carried on these studies.

Effects of Temperature and Moisture on Spread of Blister Rust

A. Effect of Temperature on Germination of Spores.

Moisture was provided and held constant in determining temperature range by germinating spores on agar in Petri dishes. Spores germinated in the following temperature ranges:

Aeciospores	54° F. to 68° F.
Urediospores	61° F. to 75° F.
Teliospores	39° F. to 68° F.

In general, the temperature ranges were in accord with those of seasons of spore development. Note that the widest range was in teliospore germination.

B. Formation of Telia

In a two-week formation period for telia, if there are 3 days when the temperature for 5 hours each day is above 82° F., this is inhibiting.

After telia are formed they can stand more heat. By late August and early September sporidia will be formed after one week of cool weather (less than 70° F.).

B. Formation of Telia (Cont.)

Sporidia were formed and cast at Madison in a 3-day cool, rainy period (Labor Day weekend, 1958). Prior to this time no sterigmata had appeared.

In Madison a 2-day rainy, cool period, October 8 - 9, 1958 was sufficient to form sporidia, but not enough to release them.

Hazard Zones

It is a long-established and well known fact that the hazard from blister rust is greatest in the northern (coolest) part of the Region, and non-existent in the southern (hottest) part. Basically, temperature is the major controlling factor. At least three separate determinations have come to the same general conclusion: (1) Observations by BRC personnel; (2) Infection data taken for Dave King's Eastern White Pine Economic Study; and (3) Van Arsdell's observations of rust incidence divided into 5 zones in Wisconsin.

In 1953 an analysis of the blister rust control problem in Region 9 was made based on data and observations. Four Risk or Hazard classes were mapped and defined in general terms, with the understanding that there is much overlapping and intermingling of these groups. The following is quoted from a paper prepared by Putnam in 1953:

"1. High Risk. (High Hazard)

"Ribes are so abundant and climate so favorable to the spread of the rust that ordinary control zone widths are not sufficient to give protection, and costs of ribes eradication are too great to be economically justified. This situation is present in a narrow band along the north shore of Lake Superior.

"2. Insurable Risk. (Medium Hazard)

"Weather conditions are generally favorable, ribes are light to medium (sometimes heavy) the cost of ribes eradication (insurance premium) is fully justified in view of pine values. If control is not accomplished and maintained, young white pine stands will not survive to commercial maturity. The great majority of white pine stands fall into this category. They occur in Michigan, Wisconsin, Minnesota, northeastern Iowa, and northern Illinois.

"3. Low Risk. (Low Hazard)

"Ribes may be present within a pine stand, and yet there is no appreciable pine infection due to weather conditions in late summer and early fall unfavorable to spread of the rust. Sustained periods of hot, dry weather prevent or retard rust spread. In the northern

"3. Low Risk. (Low Hazard) (Cont.)

parts of Ohio and Indiana, no serious outbreaks of infection on white pine have been found during the past 20 years, although some rust on ribes and scattered pine infection does occur.

"No Risk. (No Hazard)

"No association of white pines and ribes. This situation occurs generally south of Route 40 in Indiana and Ohio, and in certain spots in the other States of the Region."

In studies of rust incidence in the three Lake States based on random sampling outlined by Dave King and made by the BRC organization, the results were fairly comparable. Our Risks 1 and 2 (High and Insurable) were combined into High Hazard and included northeastern quarter of Minnesota, northern half of Wisconsin, and Upper Michigan. Medium Hazard included central Minnesota, central Wisconsin. Low Hazard included southern portions of Minnesota and Wisconsin, and all of Lower Michigan. Our appraisal in Lower Michigan differed in that we showed that area chiefly in the "Insurable Risk" (Medium Hazard) zone.

Van Arsdell reported his observations on relation of climate to incidence of rust in Wisconsin as quoted from his 1958 report:

"----- The gradation in blister rust infection on pine has been found to parallel the climatic gradation from the warmest to the coolest part of the State, based on summer records. The blister rust infection-climatic variation can be divided into 4 or 5 zones, each with various blister rust intensities and control problems. Progress along this line has been made with evidence that latitude, elevation, summer temperature and rainfall are the principal controlling features. The warmest part of Wisconsin (tentatively called Zone 1) had no rust on pine; the next zone (Zone 2) had rust confined to locally cooler and wetter sites; the third zone had rust only when ribes were nearby, and the fourth and fifth zones would include areas of such a favorable climate that white pines are infected with rust where few ribes were present, or even where ribes are great distances from the pine. The divisions between the first 3 zones are fairly well defined; the other 3 (??) margins are speculative. Studies reported here relate to programs aimed at solving the individual problems of growing white pine in each zone."

Effect of Elevation on Rust Spread in Low Hazard Zone

In analyzing and correlating weather records at different elevations with blister rust spread in southern Wisconsin, Van Arsdell found evidence of the importance of elevation. He learned that during 3 spring and summer months half again as much rain fell on the ridge as on the broad river valleys. Also, weather records showed that the average August daily maximum temperature decreased $\frac{3}{4}$ of a degree Fahrenheit for each 100-foot increase in elevation.

Tentatively he correlated rust infection with elevation in southern Wisconsin as follows:

- Below 900 feet - rust practically absent.
- 900 to 1,000 feet - rust confined to micro-climatically cooled sites.
- 1,000 to 1,100 feet - rust always present on micro-climatically cooled sites, and occasionally elsewhere.
- 1,100 to 1,200 feet - rust on all sites.
- Over 1,200 feet - rust on all sites, and occasionally severe.

Guide to Evaluating Sites

In Van Arsdell's thesis he tentatively gave values to certain topographic and vegetative features of a given site to assist in making a decision as to probable rust activity on that site. It must be emphasized that values apply only to southern Wisconsin, that they are only tentative, and are exclusive of elevation. His table of values is quoted below:

"Topographic factor	Value Assigned
Sheltered valley	10
"Position classes	
Base of slope	5
On the slope	2
Shoulder of the slope	- 2
Kettle holes	10
Flat	0
"Slope percent classes	
0 - 3 percent	0
3 - 20 percent	5
20 - 50 percent	3
50 - 100 percent	2
Over 100 percent	- 2
"Exposure direction classes	
North facing slopes	2
South facing slopes	0
None	0
"Vegetative cover classes	
Complete crown canopy	0
Small opening	10
Large opening, or in open	0
Brush	3"

It is assumed that ribes are present. If the appraisal adds up to 10 or more, ribes eradication is indicated; if less than 10, white pine can safely be planted or grown without ribes eradication.

Spread of Rust from Swamps

It is a common observation in this Region that pine infection is not generally heavy next to swamps containing an abundance of ribes. Cases are numerous where white pine plantations adjoining swamps show much less infection next to swamps than farther away, even where ribes are scarce or absent. Indeed, this phenomenon is so common that for the past 15 years or so ribes eradication plans have included the eradication of ribes in only the outer edge of a swamp.

Van Arsdell, since his return from the Army, has demonstrated satisfactorily a reason for this situation. By the use of smoke bombs he has shown the movement of air where an open slope joins a swamp. He has pictures demonstrating this movement.

During the night the open slope is cooled by radiation, while the swamp is warmer. Thus, the colder air drains into the swamp, is warmed and forced upward by the continuing colder air from the slope. This warmer air then has a reverse flow above the crowns in the swamp along the top of the inversion layer towards the top of the open slope. This is aided by the fact that in the daytime spores produced on swamp ribes can thus be carried over the heads of the pines nearest the swamp and can cause infection of pines higher up and away from the swamp.

Future Work

- A. Further studies are needed to determine how far the air currents go into the swamp in making this cycle. This is important in determining the distance into the swamp ribes eradication should be done.
 - B. Further studies leading to a refinement of factors to be considered in evaluating a white pine site from the standpoint of whether or not ribes eradication is necessary.
 - C. Studies leading to a pathologically sound basis for protection zone widths in different cover types.
- (b) Significance of Micro-climate in Forest Disease Incidence and Control
by Dr. T. S. Buchanan

While we have a few diseases caused directly by unfavorable climatic factors, noxious fumes and the like, most of our important forest tree diseases are caused by specific fungi or other lower forms of plant life. Now we can have a whole forest of trees and a whole forest full of fungi and still not have any disease. In order to have disease the proper causal organism and the proper susceptibles have to get together. This "getting together" isn't always too simple a process and what happens thereafter is still more complex so perhaps it would be well to first define a few terms so as better to understand what does go on in the disease process.

A pathological sequence begins with the arrival of an infective body of a pathogenic organism, includes that period in its life history during which it is continuously associated with an individual suscept, and ends usually with the death of the pathogen accompanying death or recovery of the suscept.

You can see that a pathological sequence is to a disease about like a life cycle is to a living organism.

Before a pathological sequence can be initiated, however, it must be preceeded by dispersal of the inoculum from its source. Thus it is perfectly evident that we can nip the whole disease process in the bud by eliminating the source or preventing dispersal of the inoculum. Except for those rare cases where a disease-causing organism requires an alternate host (and where the alternate host has no commercial value) it is usually economically impracticable at our present level of intensity of forestry practice to attempt control of well established forest tree diseases by eliminating or even materially reducing the supply of inoculum. But the possibility of hampering the dispersal of the inoculum is another matter. Most of our disease causing organisms reproduce by means of spores and these spores are disseminated primarily by air currents, splashing rains, or some animal vector, most commonly some species of insect. Alteration of micro-climate will thus influence the spread of the inoculum, either through direct effect or indirectly by influencing the activity and effectiveness of an insect vector. By these means we could, theoretically at least, get some measure of disease control even before a pathological sequence is initiated.

Following dispersal of the inoculum, a pathological sequence is characterized by three successive series of activities:

1. Inoculation - the arrival of inoculum at the infection court, the place on or in the suscept or substrate where infection first takes place.
2. Incubation - the revival of activity by the inoculum (germination) at an infection court, ingress of the pathogen, and development resulting in initiation of disturbance of normal activities and structure.
3. Infection - subsequent activities of the pathogen or saprogen in association with the inoculated suscept or substrate.

It is pretty obvious that climate must also exert a profound influence on two of these three critical happenings: - incubation and infection.

Thus in this "getting together" process and in the staying together, too, climate is most important. We could truthfully say that in order to have disease we have to have the causal organism and the appropriate suscept brought together in a favorable climate. Stated another way; even though prolificacy and spreading ability might seem to assure biological success to plant pathogens, they must still reckon with their hosts and with the weather. And the only

reason we talk about micro-climate instead of just climate or weather is to define the size of area and the period of time we are interested in and the size of the area and the time of concern during the critical phases of a pathological sequence. The weather of north Idaho in general is really not too important to the infection of white pines by Cronartium ribicola but the micro-climate (moisture and temperature) immediately surrounding a sporidium when germinating on a pine needle is extremely critical. In fact, unless these micro-climatic factors are within the proper limits, there will be no resultant infection, no matter how favorable the weather.

Now let's consider another definition - epiphytology - the study or description of factors, other than the mere presence and contact of suspect and pathogen, which influence the occurrence, course, and severity of infectious diseases. The principal essentials of life for any fungus are:

1. Food
2. Moisture
3. Oxygen
4. Favorable temperature

Since the tree suspect forms the food supply for the fungus pathogen, there are only climatic factors left to "influence the occurrence, course, and severity of infectious diseases." Again we could almost define epiphytology as the study of the effect of climate on the progress of disease.

We can, of course, control disease by eliminating the causal organism's food supply or by rendering its normal food supply unattainable. Eliminating the food supply is what we do, for example, when we eradicate Ribes bushes - and in the specific example of white pine blister rust we also, in so doing, reduce the source of inoculum which is essential to the initiation of a pathological sequence. Whenever we spray or dust a white pine with fungicidal chemicals, or make certain changes in its genetic make-up, we are, in effect, rendering the normal food supply unattainable to the blister rust fungus. Thus it can be seen that most of our direct forest disease control programs are aimed at creating an unfavorable food supply or reducing the abundance of inoculum.

In indirect control we may also slightly modify the food supply or reduce the source of inoculum but more commonly we seek to alter the available moisture supply or to create temperatures unfavorable to the pathogen. Thus our efforts at indirect control are essentially in the realm of creating an unfavorable micro-climate. The tools we have to work with are those of the silviculturist.

Moisture is an especially important limiting factor during the incubation stage of a pathological sequence as most fungus spores require liquid water for germination. Gentle rains and heavy dews and fogs are the most favorable natural sources of this moisture. While we cannot presently effectively control rains or fogs we can to some extent control

dew formation and we can exert some influence on the duration of the liquid moisture formed from any source. This is important, too, for not only is the presence of moisture essential to spore germination but it must be available for at least a minimum period of time.

Temperature not only influences spore germination but all fungus activity thereafter. While each specific fungus has its own range of temperatures under which it can at least survive, each also has certain limiting minimum and maximum temperature requirements and an optimum under which it best flourishes. And once again time also becomes a limiting factor.

Moisture and temperature directly influence the development of a pathological sequence but there are also other contributing weather factors indirectly exerting some influence, especially during the inoculation stage. Remember inoculation was defined to include the arrival of the inoculum at the infection court. Now with many of our tree diseases, perhaps we can safely say for most of our tree diseases, (oak wilt and our heart rots as specific examples), wounds are the major infection courts. Snow and ice breakage, glaze injury, hail damage, and wind damage may all make ideal infection courts and all are weather induced.

I think it obvious that if we had perfect climatic control (call it micro-climate or weather control if you wish) over a designated problem area we could control most of our forest tree diseases. We do not yet and probably never will have this perfect control but we can exert some control, especially over limited areas and still more especially over minute areas where we are properly concerned with micro-climate. To exert this influence the silviculturist has several tools at his disposal:

1. Spacing (planting, thinnings, and partial cuttings)

Variations in spacing can influence local temperatures and local air currents which in turn influence the duration of free water on the surface of susceptibles. What the specific requirements of the pathogen are and what is made less favorable is not known, but it is established that hypoxylon canker of aspen, for example, is less of a problem in well stocked, than in sparsely stocked stands. It seems logical to assume, however, that an unfavorable climatic condition must be created in such stands, if not for the pathogen, perhaps for some unknown vector.

2. Stand composition

Here the silviculturist can use broadleaved or coniferous species or mixtures thereof to develop stands of different canopy levels and densities and thereby vastly alter local temperature and moisture conditions. In this manipulation the silviculturist can at the same time make species selections that do not provide a favorable source of food for a given pathogen.

3. Site selection

Topographic position, elevation, slope, and exposure are known to influence disease incidence and severity as well as tree growth. Certainly climatic influences are involved here and proper choice of site for a specific tree species susceptible to attack by a specific fungus should help considerably to reduce disease incidence and severity. Hawksworth's finding, for example, that dwarfmistletoe does not occur on lodgepole pine growing above 10,700 feet in central Colorado is doubtless conditioned by the low temperatures at that elevation rather than by elevation per se.

4. Pruning

Pruning can greatly influence moisture, temperature, and also light conditions over a limited local area. Spruce plantings have been essentially freed of *Cytospora* trunk canker infections on an experimental basis by the simple expedient of judicious thinning and pruning. Here again it is hard to visualize that anything other than altered micro-climate is responsible.

These are just general and specific examples of what might be done to control tree diseases through climatic manipulation. Obviously a lot more research needs to be done, both on the climatic requirements of each disease-producing organism and on how and to what extent silvicultural manipulations may alter micro-climatic conditions in the forest. Nevertheless I cannot help but feel micro-climatic manipulation to be the most promising approach to indirect control of forest tree diseases.

Finally, knowledge of micro-climatic influences is important to forest tree disease control even where we make no attempt to change it. To be able to measure and recognize micro-climatic factors and micro-climatic influences permits us more intelligently and economically to apply our direct control measures. This may, in fact, be the most important aspect of micro-climatic studies. This is exactly the way our micro-climatic work in connection with white pine blister rust is headed - enabling us to identify areas where direct control (ribes eradication) can be relaxed or where it needs to be intensified.

3. State Management of Cooperative BRC.

- (a) Situation in R-7: efficiency, organization and Forest Service Role in State Operated Programs
G. R. Allison, Discussion Leader

In Regions 7 and 8 we have 17-1/4 million acres of blister rust control area. Within this control area we have 7.3 million acres of white pine. At the end of 1958 over 92% of the control area was on maintenance. Over 88% of this vast acreage is privately-owned and these, for the most part, are in small ownerships--woodlots of less than 100 acres. Practically none of the pine acreage is owned by large timberland companies. The blister rust control problem is largely one of cooperation with States, Townships and private individuals.

Organization of BRC in Northeast

- (1) Before 1950 each state with a control program was under the direction of a BRC State Leader. He had anywhere from 2 to 10 or more districts to supervise. In 1950 the Northeast was reorganized into Areas. Area Leaders replaced State Leaders and supervised BRC Districts in two or more states. Nearly all equipment and motor vehicles were federally-owned.
- (2) Cooperation with states was good. The federal BRC organization planned the program, did the work and made the reports. All the State cooperator needed to do was furnish his share of the money. From a functional program point of view this was excellent. The BRC organization could and did give its individual attention to blister rust control. The most difficult job was to get the cooperator to maintain sufficient interest so that he would contribute a fair share of control costs.

Forest Service Policy

With the transfer of BRC into the Forest Service in January 1954, it was necessary to review the possibilities of BRC under the Forest Service policy.

In cooperative programs with the States the Forest Service has followed the policy of participating financially and in a broad directing and coordinating role. The State is responsible for operating the program. This policy is followed because it encourages the State to develop strong State Forester organizations capable of performing planting, management, fire control, pest control, watershed management and other functions of a broad forestry program.

During the two years following the transfer the pros and cons were carefully evaluated.

Aside from the personnel problem of changing from a federal to a state operated program, we felt we would lose the single function, one goal approach that had guided the BRC control effort that accomplished so much. However, when weighed with a broad overall view it was felt that BR should eventually follow the Forest Service policy.

Transition

After a very careful observation and analysis of the BRC program in Region 7, the decision was to develop a gradual change from the Federal operated program to one largely State operated. This gradual change was most essential, since the States had neither trained personnel nor equipment to handle the program. Likewise the Federal personnel for the BRC project had from 15 to 35 years of service that should in no way be jeopardized. Roy W. Olson, Assistant Regional Forester, Division of State and Private Forestry has largely been responsible for the careful and systematic approach that is working, we think, to everyone's advantage.

A. Reimbursement

The first step was to encourage more active participation on the part of State cooperators. Through the reimbursement procedure we are accomplishing this objective with some very real benefits to the program such as:

- (1) Reduced payroll duplication
- (2) Reduced business administration
- (3) We have obtained key State field personnel in four additional States. With the exception of two States BRC activities were supervised by Federal District Leaders. Today these Leaders direct State Supervisors.
- (4) Some State-owned vehicles have been acquired.
- (5) There is considerably more interest in some States on program planning, organizing and financing.
- (6) With the addition of key State people we have enlarged the scope of District responsibilities as some of the personnel have retired. We think it will make a better District job, from one of planning current work, running crews, checking and performing I&E work, to a job of administration, organization, program planning, checking and I&E direction.

The rate with which we accomplish complete reimbursement is contingent upon many factors: State laws; acquisition of equipment; development of trained personnel; our willingness to effect the transition subject to retaining the basic responsibilities envisioned in the Lea Act.

B. Other Benefits or Losses

- (1) We believe this approach has strengthened our cooperative effort on other pest control. Conceivably we could dilute our BRC effort in the over-all pest control program but so far I do not believe that this has or is happening.

B. Other Benefits or Losses (Cont.)

- (2) In those States where pest control is a responsibility of the State Forester, we believe BRC is in a better position than it was before. Cooperative BRC funds were \$386,800 last year, an increase of nearly \$75,000 over 1954. It is nearly four times the amount of Federal cooperative BRC money (411) that we are putting into the program.
- (3) So far our technical direction has not suffered or weakened. Actually by the change in emphasis of the District Leader's job we believe we will strengthen the technical contribution. (Ecology, micro-climate, chemical eradication, pine evaluation, etc.)
- (4) We believe we are in a better position to participate in the small woodland ownership program through our closer integration with other forestry programs.

C. Cooperation

I firmly believe that the success of any cooperative program is no better than the cooperative integrity of the individuals. We can have agreements, understandings, letters and other binding documents, but the real cooperation is in the individual and it is based on solid honesty.

Ultimate Organization

We have definite concepts in mind but we believe we should not hold to a rigid pattern. We hope to maintain a Federal man in each State. He would work with the State Forester or Pest Control official. We visualize his job as one of planning, broad supervision, training, technical guidance and coordination.

In Vermont we now have one Federal man in place of three former District Leaders. He works with the Assistant State Forester in charge of Pest Control. Together they formulate the State program of work, develop State BRC policies and provide over-all direction. The Federal man supervises maintenance of the pine inventory records, makes reports, trains State Supervisors, checks the work, lends over-all guidance and due to the dependence on local town funds, directs a very active I&E program.

We believe this arrangement to be satisfactory and beneficial to the State. We like it. We maintain a strong influence in the guidance of the program, we obtain good reports and obtain a satisfactory quality of control work.

It is my sincere belief that the Federal organization must provide a service to the State in the form of financial aid, technical guidance and

coordination or we have no place in the State set-up. I hope that we can keep a few paces ahead of the States in the development of chemical control, in the use of fungicides, in eradication technique, survey methods, inventory procedures and other essential BRC functions so that we can offer a genuine service to the States. If we can do this we should have no difficulty in maintaining a place of welcome in cooperative BRC programs.

The Forest Service Role in the Conduct of BRC Operation in R-7

A. Regional Office

We work with State officials and Area Leaders in formulating broad policies, long-range plans and financing. We coordinate BRC with other State cooperative forestry programs. We endeavor to coordinate the State BRC program with servicewide plans and policies.

We provide leadership and supervise the formulation of regional guidelines, standards, methods and techniques. We evaluate program organization and effectiveness.

B. The Area Leader

In the job of cooperation the Area Leader is an extension of the R.O. We work together on this important activity. However, by his location in the field, the Area Leader is able to maintain good working relations with the cooperators and direct an active I&E program at the field level.

The third major task of the Area Leader is supervising District Leaders and evaluating their conduct of program work against standards.

C. District Leaders

We have already discussed to some extent the duties of the District Leader. You can see that we are in a state of gradual change. Eventually he probably will take over that part of the Area Leader's job of preparing current work plans with the State cooperator and of keeping the State currently advised at all times of the BRC program. We are anxious to arrive at this point so that the Area Leader can devote more time and attention to program evaluation in each State and to such activities as checking, developing standards and methods and directing an active I&E program at the State level.

April 22 - Chairman - T. H. Harris
Recorders - Quick, Bega, Lloyd

1. Maintenance Work Procedures

- (a) Present methods: contemplated changes if any: need for improvement.
In Region 1 Homer Hartman, Discussion Leader

Rust first came into North Idaho in 1923 in about one-half dozen centers. These were discovered in 1926 or 1927. Following these discoveries, the Clarkia area on the St. Joe National Forest was scouted in 1927, 1928, and 1929. Rust was not found but in 1933 90% of pine within 10 chains of St. Maries River above Clarkia was infected. Now rust is everywhere in WWP areas of North Idaho. Stands are normally exposed to blister rust about 100 years. Rust damage is cumulative. Such conditions demand rigid standards of control over wide areas.

Maintenance: Ribes have been reduced to low populations and are stabilized or on the decline.

Maintenance Standards in R-1: Last working before maintenance working: 25 RA or less taken off; no seedlings Standard by check; 2 ribes per acre or less; 5 FLS per acre or less.

Never go to maintenance at once. Series of workings to closer and closer standards. Maintenance is established control. Maintenance work is maintaining that control. In R-1 look at maintenance areas about every 5 years with a status check, 10% systematic check. Ribes seeds survive burns under rotten logs on the ground. Rodents turn over soil and get seed to surface slowly. Acti-dione offers great promise against the last bush.

Viche: Seeds on areas are eventually exhausted.

Benedict: What effect will the use of Acti-dione have on this condition with what now known? Will present knowledge change the maintenance system? Acti-dione conceivably will lower costs of maintenance.

Hartman: We are now in position to gamble a little. We can wait and catch up if we get behind.

Allison: Change ribes eradication from insurance basis to control actual rust damage?

Viche: Change from status survey to disease damage survey?

Wessela: Shows curve of slow progress toward maintenance.

Viche: In R-1 areas can go to and from maintenance, back and forth. Once on maintenance not always on maintenance.

Benedict: Maintenance commonly holds until a major disturbance takes place.

Viche: Some 275 M - 300 M acres in program (about 25%) never worked yet because need is not urgent.

Benedict: Patterns of handling and reporting maintenance not uniform with regions. Same with reporting of ribes eradication accomplishments.

Hartman: Pinch: Lots of areas to search; get 1 R/A, takes 1 MD/A, and \$30. Stream-type is never put on maintenance. Check and eradicate every 5 years.

Putnam: Little actual reality in maintenance concept to the eradication man in field.

In Region 5 Roy Blomstrom, Discussion Leader

Described, as introduction, a modified type of search, 8 times as fast as regular strip checking. Briefly explained distribution of sugar pine in California. Range of habitat conditions over sugar pine areas great. Showed map of commercial range of sugar pine, and 4 zones of B.R. infection. Zone 1 blister rust epidemic and "rough". (N.W. part State) Zone 2, to Highway US #50, rust epidemic in spots only. Zone 3, Eldorado N.F. and Stanislaus N.F. (part); rust inactive, centers largely eliminated south of N. Fork of Tuolumne River.

Zone 4, no known rust. No more initial eradication done in Zone 4 but will complete eradication started. In zones 3 and 4 ecological control is the objective. In zone 2 a mixture of controls and standards by hazards; high, medium, low are used. In zone 1, close standards are necessary, none above 15 FLS/A; often closer. Problem in R-5; Where should we change standards of control?

Neil MacGregor in 1955 started checking a strip 1 chain wide; took ecological data, eliminated pacing, estimated distance. Checkers are also eradicators, one man crews; chain wide strip 10 chains apart equals 10% check. Records kept by 5 chain transects. Remove ribes as they progress unless numerous. If numerous worked by crews or contracted. Checker covers 6-8 strip acres per day. Get much better ribes distribution pattern than with regular strip checking. A lot of eradication is also done by checkers. Crews work marked spots. May run additional strips. Repeat: We get much better pattern of ribes distribution on maintenance areas. Large areas with many ribes contracted or crew worked.

Putnam: Why eradicate at all in Zone 4? Safety.

Allison: Would you explain ecological control and ecological standards?

Blomstrom: Gave short explanation. Population growth, production seeds, seed longevity.

"Rerun Results for Ribes Size Classes" Table.

"Rerun Results for Half-Acre Transects" Table.

Both show effectiveness of chain-wide check method.

"Estimation of Pacing" Table 41 5-chain transects.

In Region 6 Lyle Anderson, Discussion Leader

There are 205M acres of control area in R-6, 60M acres of which are on the Rogue River N.F. in near continuous block. This is in an intensive management area, 70-80MM allowable cut in working circle. In R-6, 695M acres WWPine type and 365M acres of SP type not under control.

Maintenance in R-6 is bases on 40/A units. "Crown Cleaning" (canker removed) may qualify area for maintenance. There are 80-90 spots (about 1500 A) of SP plantings on clear cut burns on Rogue River area. Disturbance carefully checked and watched by use cutting records and observation. Disturbance check (informal inspection) made usually 2 years after disturbance. Usually post-checked 4 years after disturbance. Inspections spaced to planned and emergency logging activity. Variation of ribes conditions due to original cover, burn intensity, etc. Prospect flat is still getting a lot of "Long distance spread".

Maintenance crew is commonly checker and 2 flanking men, get 30-40 acres a day. Strips are $2\frac{1}{2}$ chains apart. Plotted on 16" to mile map. Now have good detailed eradication history over sizeable area. Amount of disease may determine maintenance status. Ribes conditions and problems vary with 4-5 types of cuttings. Last bad rust year was 1947. Umpqua N.F. has much same type operation as Rogue River N.F. R-6 runs lots of damage (infection) surveys; use continuous systematic strip; all crop-trees inspected; cankers are aged, etc. Have sets of 1 acre and $1/5$ acre study plots. Ribes, pines, rust recorded in detail on these plots.

In Regions 7 & 8 J. R. George, Discussion Leader

INTRODUCTION

The Region 7 and 8 program is a matter of maintaining control rather than achieving it. It has been that type of program right from the start in most areas from Virginia south, since blister rust had not made serious inroads at the time the program started. The same was not true, however, for the States from Pennsylvania north where blister rust established its foothold in this country. Today this business of maintaining control is the basic blister rust job from Maine to Georgia. The present control area contains 17 million acres involving over 7 million acres of white pine, 92.3% of which is on maintenance. This varies from 78% in Vermont to 100% in six States.

EXAMINATION OF AREAS

Most areas when placed on maintenance are scheduled for examination at ten year intervals with an intervening five year cursory check for disturbances. The disturbance check is a winter operation while the ten year check may be scheduled at any time during the year. Where the winter examinations do not give all the answers desired, especially with regard to the location and numbers of ribes, a summer check is scheduled to make the final determinations.

Examinations are made by one or two men. In the rugged, remote mountain areas we prefer that two men work as a team as a matter of safety.

Some areas are checked by running formal strips but we find that sampling in such a manner requires a high percentage sample to get a fairly accurate picture of conditions and to take the proper sample approximates minimum crew coverage. A much better picture can be obtained by using individuals highly trained in scouting for ribes and having them make random checks of the most likely spots where ribes would grow. The use of such individuals makes possible a much higher rate of coverage per man-day since many sites that would normally be covered by running formal strips can be eliminated with very little footwork.

Examination of areas is not confined to looking for ribes. On many sites, looking for blister rust itself determines current needs. This is particularly true on so called ribes-free areas that were placed on maintenance following the original survey. When a pocket of recent infection is found, the search for the guilty bushes is an interesting one. A careful study of the patterns has lead to an ever-diminishing control zone width. This reduction in control zone width is extremely important in keeping maintenance costs to a minimum.

WHITE PINE PATTERN

The pine pattern for the East varies greatly from the Northeast with its almost pure stands, to the Virginias with their oak-pine mixtures, Tennessee and the Carolinas with pure stands in the mountain areas, and north Georgia with mixtures of poplar and pine in the deep coves.

RIBES DISTRIBUTION PATTERN

The ribes distribution pattern varies greatly too. The Northeast has a general distribution, the Virginias a spotty distribution with practically no bushes in the valleys, scattered patches along the mountain streams and on the north slopes, and general distribution above 3,000 feet. Farther south the distribution becomes even more spotty with general distribution limited to the highlands.

Recent ecological studies indicate that there may be a pattern for distribution in the Northeast that would be a great aid in predicting future ribes potential of given sites. To my knowledge, the spotty distribution of the Southern Appalachians has not shown such possibilities. Perhaps the fire history of many sites is closely related to the ribes distribution pattern, but what to expect in the future on thousands of acres now classified as ribes-free is a real enigma in long-range planning.

THE PLANTATION PROBLEM

With rapidly expanding programs in many states, getting white pine into sites where initial control and future maintenance costs are low is a real chore. Some recent observations almost have me convinced that it is a lost cause. We have taken several steps to assist foresters with site selection.

1. We have provided general guidelines both at the State Forester and Service Forester levels. The Service Forester guidelines are kept simple with the hope that they will be read and followed. These are given to the Service Forester by the District Leader during a visit with him. The whole problem is discussed at Service Forester meetings.
2. In states where ribes are not generally distributed, District Foresters, SCS representatives and others involved in planting are provided with ribes distribution maps. Although they are quite general they do serve both as a guide and a reminder of danger.
3. To allow as much freedom in planting as possible, an attempt has been made to encourage planting below a specified elevation in certain states or sections of states where ribes do not normally occur at lower elevations.
4. On national forest lands, the forests report areas where planting is planned to the District Leaders. Each site is reviewed and a report is made to the forest regarding the ribes situation. If records do not clearly reflect the situation a field examination is made.

CUTTING

One of the problems on maintenance areas is accelerated cutting on sites with pine in the understory. Many of these areas did not have sufficient white pine to be included on previous surveys and the slow-growing hardwoods may have suppressed former ribes populations. We are sure that many thousands of these cut-over acres are going to be white pine areas but we do not know or do not have enough background information to anticipate our ribes problem.

On national forest lands, to keep control costs to a minimum, arrangements have been made for rangers to keep district leaders informed regarding cutting plans. Where a cut is scheduled during or shortly after scheduled BRC work, the work is often advanced so that it can be completed before the ground is covered with slash.

Rangers are provided with a map of their district with a pine overlay on it. When conditions are observed by personnel which may be of interest to the BR district leader the location and condition is noted on a blank map which is sent to the district leader. Such things as new reproduction, ribes locations and recent infections are so reported. District foresters are encouraged to provide similar information for private lands but BR people usually have to depend on frequent contacts to obtain such information.

LOW HAZARD AREAS

There are certain areas where blister rust has not developed normally on white pine even though ribes have been found. Some of these areas are being placed in a "no further work" category. Occasional checks for disease will be made in them but they will not receive the regular examination planned for other areas on maintenance. In Region 8 there are sizeable areas where conditions apparently have not been conducive to rust spread from ribes to pine. We would like to find the reasons for this lack of infection with the hope that such areas can be completely eliminated as a problem.

LACK OF INFECTION

In the East the continuing success of the control program creates a problem in itself. As the trees infected years ago pass from the scene, so do those who vividly remember the damage that can occur. Young foresters are not easily convinced that the disease can do major damage when they can view nice stands without even a flag. This factor alone requires more and more emphasis on a vigorous educational program.

WHITE PINE WEEVIL

Through the years we have learned that blister rust can be controlled effectively and we feel certain control can be maintained as a sound economic practice.

White pine weevil is the spectacular pest today and it does a great deal of damage in much of Region 7. Control of this pest, particularly in young stands would add tremendously to the value of young stands and the volume of quality lumber needed at the turn of the century.

As part of our maintenance program we are preaching weevil control, getting people started in a spray program and showing them results. We believe such action can really make our efforts in blister rust control pay off.

In Region 9 S. D. Adams, Discussion Leader

Maintenance Work Procedures

1. What is meant by "maintenance"?

Maintenance is a term which describes a generally ribes-free condition, where control has been established and the existing pine stand will be free from blister rust damage until maturity unless disturbances such as fire or logging occur. The objective of the BRC program is to place all valuable pine stands on maintenance as quickly as possible.

2. What is meant by "maintenance work"?

When additional work is needed periodically to preserve this maintenance condition such work is called "maintenance work".

3. How is maintenance work performed?

- a. Is maintenance work needed? An informal inspection of the area is made to determine whether rust is coming in to the area. If there is no evidence of new rust the area is passed over.

If rust is building up, an intensive post check is conducted to fix the ribes pattern. Areas needing additional work are then designated and worked by:

- (1) A standard 3-man crew.
- (2) A 2-man crew, or
- (3) One man who is particularly skilled in cleanup eradication techniques.

- b. An area "on maintenance" is considered as a "whole". If any maintenance work is done as a result of the post check, the entire acreage is considered to have been covered by maintenance work and so reported.

4. Status of Control

The status of blister rust control in Region 9 as of December 31, 1958 is shown in the following table:

Ownership	Control Area	Initially Worked		On Maintenance	
		Acres	Percent	Acres	Percent
National For.	361,000	344,000	95	258,000	72
Ind. Reser.	142,000	138,000	97	117,000	82
Non-Fed. Public	962,000	864,000	90	445,000	46
Private	2,325,000	1,917,000	82	978,000	42
Region 9	3,790,000	3,263,000	86	1,799,000	48

5. What changes are necessary?

As long as our permanent men remain as closely associated with the work areas as they are at present, our maintenance work procedures are sound. Procedure changes will be needed to keep pace with personnel structural changes.

- a. Maintenance areas should be scheduled for periodic inspections as a part of the long-range work plan.
- b. A more intensive type of infection survey is needed since an informal inspection might miss the rust if such is light and sparsely scattered.
- c. When inexperienced men are to be used to ~~perform~~ the post check a more systematic checking procedure will be needed, including:
 - (1) Formal training sessions for new men.
 - (2) Detailed instructions for performing field work and keeping records.
 - (3) Methods for checking on the accuracy of the checker.

2. K.V.Financing

Importance to program trends; problems.

In Region 1 Henry Viche, Discussion Leader

Introduced George DeJarnette for a few words. Mr. DeJarnette stated that the K-V law was enacted in 1930 to "plow back" part of stumpage returns in order to leave areas in productive condition, and to improve the stand. Maximum K-V deductions are tied to overall cost of planting. The law contains such words as: "Removal of undesirable growth" also "To improve the future stand of timber." Not planned to do entire BRC work on any area with K-V money. Industry doesn't like our privilege to collect and use K-V funds. Very desirable source funds for forest use. Keep clear of criticism and abuses in order to continue its use. Keep on reasonable and logical planned basis. Tied to establishment of stand, not to protection of established stand.

Mr. Viche then continued the discussion.

On the area cut over by the purchaser, certain pooling arrangements and cost of roads comes out of sale proceeds first, sometimes leaving little for K-V. Shrinkage by "deducts" (common services) is also considerable. K-V collections in R-1 average, \$1.35-1.40/MBF. Must be based on detailed K-V plan for any collection. Written up in the sale appraisal. Money not tied to fiscal years. Available until utilized, but commonly limited to 10-12 years.

Importance: 1953 - \$25M, 1958 - \$100M. K-V funds collected for BRC now total \$700M. Have worked 20M acres used \$300M K-V on BRC in and since 1953. Trends are toward less K-V money for BRC. Maximum authorization \$84.50/A for K-V on WWP areas. Planting preparation 15-\$20 acres, planting 60-\$70/A. Less left over BRC!

In Region 5 T. H. Harris, Discussion Leader

R-5 feels that Lea Act (regular appropriation) funds are generally adequate for BRC in California. If K-V funds are used, Lea Act position may be weakened.

Use of K-V on silvicultural uses in California (other than BRC) is not up to desirable level. Some factions of industry in California are strongly opposed to BRC per se. Some are also very critical of K-V money collections and uses. K-V money may minimize returns to counties also.

Benedict made the following comments. Augmentation of appropriation might be read into using K-V funds for BRC. No trouble with GAO to date. Internal audits aware of this practice. No objection^s to date. Agrees in general with R-5 in relation to K-V situation in California but does not believe adequate regular appropriation receipt should be the argument for not using K-V funds.

In Region 6 Benton Howard, Discussion Leader

R-6 started using K-V in 1957. Used about \$8M in 1958. Maximum rates set by Forest. Can't be held more than 10 years, nor used for more than 4 eradication of ribes. Expects to hit peak in K-V use soon, then taper off.

Charles Rindt discussed use of Lea Act and K-V money on and around clearcut burns. He stated that logging itself stimulates a ribes problem which properly makes their removal a K-V charge.

3. Efficiency Checking

(a) Roy Blomstrom, Discussion Leader.

Efficiency checking is the actual (legal) inspection of contractor or force account crew work to determine quality of work done and to determine if rework is necessary. This type checking has suffered in accuracy past several years in R-5. Level of BRC experience among supervisors has become dangerously low. A checking rerun program of 1958 aroused considerable interest. It was obvious that checkers and checks left many things to be desired. A "Minimum Acceptable Checking Performance Standards" table was presented. "Bush Size" & "% of Bushes Checker Must Find" columns. +21' FLS, 90%; 9-20', 70%; 5-8', 65%; 2-4', 60%; 1' FLS & under, 50%. (These are minimum standards) The 1958 checking reruns not satisfactory in general. "Minimum Reruns Acceptable". Table. 1958 average, 55% of minimum acceptable. Checker rerun program to continue in Region 5.

(b) S. D. Adams, Discussion Leader.

Under present organizational structure is efficiency checking determining whether control standards are being attained?

A. Control Standards - R-9

1. All work is to 25 FLS, or less, per acre.
2. Force account and inmate work are usually to 15 FLS per acre.
3. Most contract work is to 10 FLS per acre and an added restriction that no bush with 10 FLS or more can be left.

In general, these standards have been adequate to attain control of the rust. On some local areas the 15 FLS standard has proved to be inadequate and perhaps a standard of 5 FLS per acre would have failed to control the rust. Fortunately, this situation is not common in the Region.

B. Who performs these efficiency checks?

1. All such checking is done by other than temporary, inexperienced personnel. The district leaders have done most of the checking, assisted by control aids or experienced foremen. On national forests, now that the work will be supervised by the rangers, checks will be made by district personnel.

C. How are efficiency checks made?

1. The standard check strip is 13.2 feet wide.
2. A 2% check of the area is required, however, a minimum of 80 chains of strip is run in every work area regardless of size. In small areas (less than 80 acres) strips are run at the interval required to produce 80 chains of check strip. On areas of 80 acres or more, strips are run at 10 chain intervals.

3. Strips are run in cardinal directions; hand compass determines direction while pacing establishes distance.
4. Ribes found are plotted by 5-chain intervals on an overlay map. The fractional recording of bushes over FLS is used.
5. The FLS per acre is computed for each work area and rework designated where standard has not been met.

At present our regular checks are determining whether control standards are being met. This situation will prevail as long as our district leaders can give close supervision to the job. On national forests men will have to be trained to make the checks. This will probably require a more detailed checking procedure than that now in use.

4. Contracting Ribes Eradication

(a) Present status, efficiency and future place.

In Region 1 Henry Viche, Discussion Leader.

Have been using contracting for 12 years; 1950 was peak year. Local labor R-1 not much interested in BRC contracting. Most of labor force in BRC over past many years have been minors. Region has set up one "economic" (1,000 acre) contracting unit on each forest by 1960. Contracts checked by checker and flankers at 4-chain intervals. On force account checking--no flanker or crew. Most of contracting has been of areas near maintenance. Mostly to zero ribes standard by check! Contractors mostly work isolated scattered areas, and camps large blocks of control area. Zero standard means no ribes found by checkers. About 10% rejection of bids because of excess over appraised price. All work by $1\frac{1}{2}$ acre lot subdivisions.

In Region 5 Roy Blomstrom, Discussion Leader.

Contracting ribes eradication was started in R-5 in 1947. Six thousand acres were covered that year. Since then a total of 262,000 acres have been covered satisfactorily by contractors. Blomstrom believes that a 40% saving in ribes eradication costs is made by contracting procedures and displayed charts for proof. In 1954, in similar areas, force account work cost \$28.82 per acre on 526 acres - contracting in a similar area cost \$7.72 per acre plus administrative costs. Charts showing average bid prices were presented. Averages - 1955 - \$6.90; 1956 - \$10.24; 1957 - \$8.51; 1958 - \$7.00. These include a few areas normally classed as spray areas. By contracting such areas in 5 acre lots bid prices ranged from \$30.00 to \$35.00 per acre.

For a successful contracting program two types of bids must be offered - regular competitive and the open market or negotiated. Control standards must be stated in every bid. In Region 5 contracts require that every 40 acres area within a contracted area must meet standards. To assure an ample supply of contractors one or two training schools are held on each forest each year for prospective contractors.

Blomstrom believes any area can be contracted regardless of ribes populations.

In Region 9 L. H. Moore, Discussion Leader

A quick glance over the history of contracting ribes eradication in Region 9 indicates that the present status of this particular activity is best expressed by the word growth. There is continued and growing use.

Contracting was first tried in 1952 to the extent of a forty acre block. Last year just less than 9 thousand acres were put out under contract.

As to efficiency of the method: the very fact that it has grown would certainly indicate that it has been found efficient and suited for use in many of our situations.

Advantages and disadvantages.

It seems to me that there will be advantages and disadvantages to any method and a weighing of these should determine its effectiveness and its continued use.

I would like to go through the advantages and disadvantages as we see them and give our reaction in length of our experience to date.

- (1) First there is the advantage of freeing technically trained people for more technical work, getting them away from supervision and records to such things as leadership enlisting interest in and support for carrying on control programs.

We feel we have reaped some such benefits and we expect there will be more as the drawing up of bid invitations and negotiating contracts becomes better understood and more routine, and as supply of reliable and experienced contractors is built up.

- (2) We also look for more efficiency and incentive in that the contractors' earnings are dependent upon his own efforts and efficiency. Here again we know that there have been such benefits and again we expect increased efficiency with more experience with the method on our part and on the contractors' part.
- (3) There should be more flexibility. We feel we have got such a benefit in meeting such things as weather conditions, scattered small tracts and isolated tracts, and we feel that there has been advantage in this respect.
- (4) There should be a removal of responsibility and we have found this to be true. Housing and feeding on the Superior National Forest for instance. Accident reports and tax collecting are two others that come readily to mind.
- (5) Lower costs. If it can be obtained, this is always an advantage. We anticipate saving a half to two-thirds.

As for disadvantage

- (1) There is always the probability that the contractor will be taken as Government employee and by his actions embarrass the Service. So far our experience has been good. There was an instance of a contractor being suspected of carelessly starting a fire, that could happen with

an employee too even with our having more control over his actions. In either case it isn't desirable.

- (2) There is the possibility of default or delay of the work.

On all but our Superior National Forest we have used informal bidding and with both types we haven't run into this. The possibility of getting and be forced to accept a too low bid would seem to be greater with formal bidding so experience has been good to date. We would expect this particular disadvantage to give us more trouble in the future with expanded use of the method and formal bidding.

- (3) More checking outweighs gains in less supervision.

To sum up, our experience indicates that the advantages outweigh the disadvantages in much of our work, and we look for increased use of contracting in Region 9 and I should add increasing efficiency along with increased use.

5. Discussion of Personnel, Organizational, and Training Problems:

Adams - R-9: Area Leaders are grade 11. District Leaders are only GS-7. Wants to get District Leaders GS-9 but has hit a stone wall on this. W. V. Benedict and W. S. Swingler believe upgrading of District Leaders is desirable. Exact ways and means of doing this appears difficult, but there are encouraging developments. Glenn Allison stated that he has a test case now being considered.

Allison - R-7: Now has 20 District Leaders. 17 of these men are eligible for retirement by 1965. Problem is in acquiring and training replacements.

Howard - R-6: Has a big job of training new men, mostly at the Ranger District level.

Harris - R-5: Because of heavy work loads MacGregor is being put on regionwide assignments. This means less technical supervision in National Parks. Harris brought up the question as to how far we should go in removing technical Forest Service help from National Parks. It was suggested that the problem needed considerable study. Pros and cons should be organized and submitted to the W.O.

Hartman - R-1: BRC is often the training ground for other technical areas of forestry. We've had many comments on our use and training of young men. The trouble is we lose them. How to retain enough good technically trained men is the problem.